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CANADA
DEPARTMENT OF MINES
Hon. Louis Coderre, Minister; R. W. Brock, Deputy Minister.

MINES BRANCH
Eugene Haanel, Ph.D., Director.

REPORT

ON THE

Building and Ornamental Stones

OF

CANADA

VOL. III.

PROVINCE OF QUEBEC

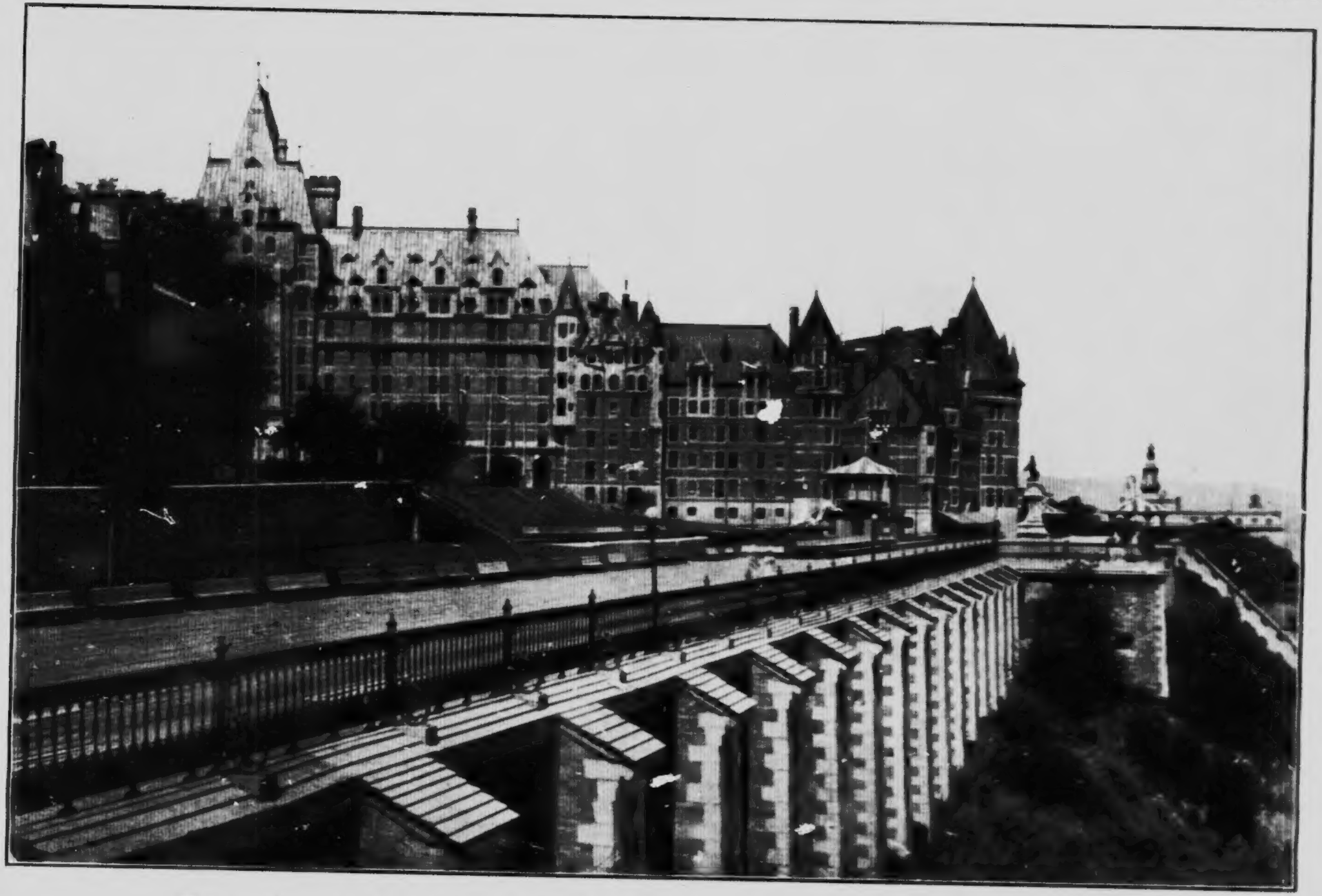
BY
Wm. A. PARKS, B.A., Ph.D.

OTTAWA
GOVERNMENT PRINTING BUREAU
1914

No. 279

Frontispiece.

PLATE I.



Sillery sandstone and St. Marc limestone. Old fortification wall and the Château Frontenac, Quebec, Que.

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No. 279

LETTER OF TRANSMITTAL.

Eugene Haanel, Ph.D.,
Director Mines Branch,
Department of Mines,
Canada.

Sir,—I have the honour to submit, herewith, the third volume of a Report on the Building and Ornamental Stones of Canada. Volume I contains two parts, the first consisting of a general introduction to the subject and the second dealing with the Building and Ornamental Stones of Ontario. The second volume contains a systematic description of the stones of the Maritime Provinces, and the present volume is devoted, in like manner, to a description of the Building and Ornamental Stones of the Province of Quebec.

I have the honour to be, Sir,

Your obedient servant,

(Signed) **W. A. Parks.**

University of Toronto,
December 23, 1913.

AUTHOR'S PREFACE

Under instructions received from the Director of the Mines Branch (Dr. Eugene Haanel) I spent about four weeks of the field season of 1911, and six weeks of the season of 1912 in making an examination of the quarries of the Province of Quebec. Later it was found advisable to carry on further investigations, in consequence of which the Director authorized three weeks additional work in 1913.

As in the case of the two previous volumes of this report, I was instructed to confine my attention as much as possible to the economic and technical aspects of the subject, and to introduce geological references only when they would be of assistance to a proper understanding of the problem presented. In accordance with these instructions I have avoided all geological detail, and in the case of the igneous rocks I have not introduced the petrographic descriptions which a geologist might expect, but footnotes have been inserted containing references to literature with which the professional geologist is familiar.

In a large and varied area such as that presented by the Province of Quebec, there are numerous small prospects and little quarries which have been opened for local consumption: it was not considered advisable to visit all of these as the time required would be out of all proportion to the value of the information gained. Many of the reported occurrences of serpentine and other decorative stones have been described by officers of the Geological Survey of Canada. As no work has been done on these prospects since the original description appeared, it was felt that a second visit would not yield results commensurate with the time and expense involved. Further, these reported occurrences are frequently in very inaccessible places, and cannot be located without spending days on the ground. My experience in attempts to locate occurrences of this kind leads me to express the hope that geologists and others will be careful to more definitely specify their localities of occurrence. A mere reference to a 200 acre lot in a wild and uninhabited district will not suffice for the investigators of 50 years hence to re-locate the finds of to-day. In order to provide the reader with a summary of these little known occurrences I have inserted tables containing the more important references, which have been taken almost entirely from the reports of the Geological Survey.

In the case of the slate industry it was found very difficult to obtain information of value with regard to abandoned workings or undeveloped prospects, as samples taken from the surface or from old dumps are worthless as test material. Even the formational features, which one might expect to find revealed in old workings, are obscured by the action of frost or by the presence of water in the pits.

The introductory chapter is devoted to a brief account of the different kinds of stone which come within the province of this report and to a resumé of the methods of testing employed. In this connexion it is to be noted that the shearing test is introduced for the first time, and that additional experiments have been made bearing on the important subjects of porosity and absorption. The appearance of Professor Hirschwald's classic work "Handbuch der bautechnischen Gesteinprüfung" marks a signal advance in the technology of stone testing, and is responsible for the improvements mentioned above.

The systematic portion of the report is divided into chapters according to the kind of stone, i.e. limestones, sandstones, granites, etc. Within the chapters the various quarries are arranged according to the geological formations, and are then considered in geographic groups which are termed "areas." In some cases the areas are divided into "districts" and further into "groups." The individual properties are described as far as possible under the name of the owner, which is conspicuously printed in italics. The subject matter of each description is arranged in the following order, if the information is available:—

Owner,
Location,
Quarry description,
General description of the stone,
Physical tests,
Chemical analysis,
Quarrying methods,
Prices, statistics, and economic remarks,
Buildings constructed of the stone in question.

At the end of the description of an area a short summary is introduced for the benefit of readers who are not interested in individual properties. Taken with the introductory remarks at the beginning of the chapters, these summaries should serve as a guide to those readers who desire to gain a general knowledge of the stone industry of the province.

In presenting this report I beg to acknowledge my indebtedness to Dr. Haanel, Director of the Mines Branch, for his valuable advice and assistance throughout and for his kind permission to extend the field work over three seasons. I desire also to express my appreciation of the excellent work done by the Editor of the Department of Mines, Mr. S. Groves, in issuing the first volume of this report. During the field season I met with uniform kindness from quarry owners and operators throughout the province and desire to extend to them my sense of appreciation.

A large amount of laboratory work was entailed in connexion with the physical tests. This work could not have been brought to a successful conclusion without the co-operation and assistance of the gentlemen named below, to whom I desire to express my sincere thanks:—Dr. Frank D. Adams, Dean of the Faculty of Applied Science, and Professor H. M. McKay of McGill University, for permission to use the large Wicksteed machine for the crushing tests; Mr. Alexander McLean, University of Toronto, for valuable assistance in preparing material and in conducting tests; Mr. R. Marshall, University of Toronto, for making transverse and shearing tests in the engineering laboratory of the University; Professor J. C. McLennan, University of Toronto, for the use of the physical laboratory for experiments involving the use of compressed air; Dr. W. H. Ellis, University of Toronto, for the loan of apparatus.

In several instances I had difficulty in obtaining the correct spelling of French proper names: in most cases I have entered these names as they were given to me although I am aware that they are not always in accord with general practice. I desire to be relieved of responsibility in this matter and ask the indulgence of French readers and of the persons concerned.

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VOL. III.

PROVINCE OF QUEBEC.

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Wm. A. Parks, B.A., Ph.D.

VOL. III.

PROVINCE OF QUEBEC

CHAPTER I.

INTRODUCTORY.

VARIETIES OF BUILDING AND ORNAMENTAL STONES FROM THE PROVINCE OF QUEBEC. METHODS OF TESTING EMPLOYED FOR THIS REPORT WITH A SUMMARY OF RESULTS.

The Province of Quebec produces limestone of structural quality in large amount; it is rich in deposits of granite of various kinds; it is rapidly assuming a position of importance as a producer of marble, and it possesses the only important slate quarries in the Dominion. Sandstone is quarried in small amount and possibilities exist for the production of many of the rarer decorative substances.

Limestone of excellent quality is obtained on Montreal island, on Ile Jesus, and at various points north of the St. Lawrence river; it is largely quarried at Hull and at points in the Eastern Townships, such as St. Johns and St. Dominique.

Important granite quarries are located at Stanstead, in the little Megantic mountains, and at other points in the Eastern Townships. North of the St. Lawrence, producing quarries are found in Argenteuil and Ottawa counties, and to the northward of the city of Quebec at Rivière à Pierre and Roberval. Dark basic rocks commonly called "black granites" are quarried at Mount Johnson, and opportunities for the production of this class of stone are afforded by many other localities.

Decorative and structural marbles are quarried on an extensive scale at Phillipsburg, in Missisquoi county, and in the township of South Stukely. The crystalline limestones of the great Pre-Cambrian area north of the St. Lawrence present many possibilities for the production of marble.

A company has recently worked at Ste. Thècle, in Champlain county, and extensive operations are being planned for quarrying the white stone at Portage du Fort, in Pontiac county.

The production of sandstone is small and is practically limited at the present time to the hard whitish stone at Beauharnois. The Sillery sandstone near Quebec is still used in small amount, and a small quarry is operating in beds of Carboniferous sandstone on the north side of the Restigouche river. The Devonian sandstones of Gaspé present great possibilities, but they are not now being exploited.

Extensive deposits of serpentine are found in the Eastern Townships, and in the county of Grenville, but they have never produced decorative stone on a commercial scale and are not being worked at the present time.

Slate is quarried in the township of Melbourne and at Long lake, in Temiscouata county. Many other slate belts are known, the commercial possibilities of which have never been thoroughly investigated.

The rarer decorative substances, particularly garnet-bearing rock, varieties of porphyry, and the iridescent feldspars, are known to occur in the province, and may prove a source of future supply.

The ordinary tests which are commonly applied to building stone have been described in detail in the introductory portion of the first volume of this report. Experience has added somewhat to the manner of conducting the tests and interpreting the results: on this account it is thought advisable to insert a short summary of the operations, which is intended to supplement rather than to supersede the more detailed description already published.

The blocks of stone that were to be tested in full were cut by means of the diamond saw into the following pieces:

Three two inch cubes,
Two one inch cubes,
One slab, two inches by one inch and as long as the block,
One slice, one inch by one and a half inch and one quarter inch thick.

The two inch cubes were cut parallel to the bedding in the case of the stratified rocks, and parallel to the rift in the case of the igneous rocks. All cubes were ground with the bearing faces as plane and parallel as was mechanically possible. One cube was allowed to dry at the temperature of the laboratory and was employed for the obtaining of the dry crushing strength. The second cube was thoroughly soaked with water by treatment under vacuum and was used for determining the wet crushing strength. The third cube was similarly soaked and was then frozen and thawed forty times, after which its crushing strength was determined while still wet.

One of the small cubes was used for the determination of the short period absorption as described below, after which it was used for the corrosion test. The second small cube served for the determination of absorption by slow immersion, the absorption under exhaust, the absorption under pressure, and the specific gravity.

The slab was employed for the determination of transverse strength. The shorter portion after being broken was used for the shearing test, and the longer end served for the chiselling and drilling experiments. The thin slip was used for the coloured plates at the end of this volume.

The various physical tests were as follows and are recorded in the following order throughout this report:

(a) Specific gravity.
(b) Weight per cubic foot, lbs.
(c) Pore space, per cent.
(d) Ratio of absorption, per cent, one hour.
(e) “ “ per cent, two hours.
(f) “ “ per cent, slow immersion.
(g) “ “ per cent, in vacuo.
(h) “ “ per cent, under pressure.
(i) Coefficient of saturation, one hour.
(j) “ “ two hours.
(k) “ “ slow immersion.
(l) “ “ vacuum.
(m) Crushing strength lbs. per sq. in., dry.
(n) “ “ lbs. per sq. in., wet.
(o) “ “ lbs. per sq. in., wet after freezing.
(p) Transverse strength, lbs. per sq. in.
(q) Shearing strength, lbs. per sq. in.
(r) Corrosion test, loss or gain, grams per sq. in.
(s) Drilling factor, mm.
(t) Chiselling factor, grams.

(a) *The specific gravity* was determined by drying one of the small cubes at a temperature of 110°C. for 24 hours, allowing it to cool in a dessicator and weighing. The cube was then thoroughly soaked with water as described below, after which it was suspended by a fine silk thread in distilled water and weighed. The original weight divided by the loss of weight in water is the specific gravity, i.e., the ratio between the weight of the stone and the weight of the water displaced, or the ratio between equal volumes of stone and water. The difficulties in this determination lie in first expelling all the water, and second in entirely filling all the pores before the second weighing. Hirschwald considers that a temperature of 110° is too high, as it may induce changes in the stone. On the other hand, I have found that at the temperature which he recommends (50°C.) I have been unable to obtain constant readings, indicating that the water was imperfectly expelled.

The specific gravity of 26 limestones was determined, giving an average of 2.714, with a maximum for the Chazy stone at St. Dominique of 2.764, and a minimum for the Trenton stone at Joliette of 2.691.

The highest result for sandstones was obtained from the Carboniferous stone at Pointe à Bourdeau on the Restigouche—2.71, and the lowest from the almost pure quartzose sandstone from Beauharnois 2.657.

Twelve granites gave an average gravity of 2.688. The densest stone is the blue variety from Roberval—2 789, and the lightest is the reddish gneissoid rock from St. Canut —2.641.

The black granites show a maximum of 2.876 in the case of the essexite known as Canadian Quincy from Mount Johnson, while the tinguaite from Morrison's quarry in Montreal falls as low as 2.548.

The highly dolomitic crystalline limestone from Portage du Fort has a gravity of 2.868, and the Missisquoi marble is as low as 2.714. On the whole, the marbles average much higher than the sedimentary limestones.

The average gravity of four slates was found to be 2.788.

(b) *The weight per cubic foot* was calculated in the following way: The thoroughly saturated cube was weighed while still wet and the amount of water absorbed determined by subtracting the original weight from the figure obtained. From this result the pore space was determined as described below. A cubic foot of water weighs 62.426 lbs.; in consequence, the weight of a cubic foot of *solid stone* is this figure multiplied by the specific gravity of the stone. The weight of a cubic foot of *actual stone* is easily found by subtracting the pore space. Thus, if the specific gravity is 3, the weight of a cubic foot of solid stone is 62.426 × 3 = 187.278. If the pore space is 10 per cent the actual cubic foot must weigh 187.278 × 0.90 = 168.5502 lbs. It is to be remembered that the figure thus obtained applies to perfectly dry stone, a condition in which it never occurs commercially. Stone as delivered to the builder will always weigh more per cubic foot than the figures herein given. The increase cannot be tabulated, however, as it depends on the amount of pore space and the condition of the weather.

The twenty-two limestones tested are all massive rocks with a low pore space, in consequence the weight per cubic foot does not vary greatly. The average was found to be 168.31 lbs. The lowest figure, 163.326 lbs., was obtained for the Joliette stone, and the highest, 172.184 lbs., for the Chazy stone at St. Dominique. The lightest sandstone is that from Pointe à Bourdeau, on the Restigouche river, which weighs 150.5 lbs. per cubic foot, and the heaviest is the Sillery sandstone from Levis, weighing 166.674 lbs.

Twelve granites average 166.54 lbs. per cubic foot. The heaviest stone is the example from Perron's quarry at Rivière à Pierre, which weighs 171,686 lbs., and the lightest is that from the quarries of the Frontier

Granite Company at Stanhope 163.012 lbs. per cubic foot. Of the black granites the essexites from Mount Johnson range highest, reaching a maximum of 179.22.

Five marbles average a little over 172 lbs. per cubic foot. The white crystalline stone from Portage du Fort is much the heaviest, giving 178.543 as a mean result of three determinations. The Missisquoi marbles are the lightest, averaging a little over 169 lbs. The slates range from 171 lbs. to 173.6 lbs. per cubic foot.

(c) The actual *pore space* was calculated by multiplying the increase in weight of the cube on saturation by the specific gravity of the stone, and adding this amount to the original weight of the cube. The increased weight of the cube taken as a percentage of the total weight is evidently the percentage of pore space.

The most compact limestone tested is that from Lord's quarry near St. Johns, in which the pore space is only 0.081 per cent. The most porous example is the Joliette stone from the limekiln quarry, which gave 2.775 per cent. Between these extremes all gradations occur, but on the whole the Quebec limestones are to be regarded as dense and compact rocks.

The Sillery sandstone from Levis is a very compact rock for this class as its porosity is only 1.478 per cent. The typical Potsdam sandstone from Beauharnois is also of low porosity, showing 2.46 per cent, while the Carboniferous sandstone from the Restigouche reaches a porosity of 11 per cent.

The granites from Megantic and Stanhope are rather porous for this class of stone, as they average over 1 per cent. The Perron stone from Rivière à Pierre has the lowest pore space -0.355 per cent. The others range between this minimum and 1 per cent. It cannot be said therefore that any of the Quebec granites are particularly impervious. The tinguaite from the dykes in Montreal shows a porosity of 0.125 per cent, the Mount Johnson essexite averages about 0.3 per cent, and the stone from Yamaska mountain reaches a porosity of almost 1 per cent.

The marbles are but slightly porous, as the average of five examples is only 0.23 per cent. The slates show an average of 0.75 per cent, but too few were tested to make the average of any value.

(d) *The ratio of absorption* is the amount of water absorbed expressed as a percentage of the original weight of the stone. It is evident that the ratio of absorption may be determined for different conditions of soaking, and that the results may be of value in predicting the absorbent power of the stone in different positions in an edifice. For instance, a soaking of one hour may be comparable with the degree of absorption that a stone exposed to occasional showers would undergo; but it is not comparable with the absorption that would take place in the same stone below the level of the ground. For other reasons that will be referred to under "Coefficient of Saturation" it is desirable to know the ratio of absorption under different conditions. The first determination was made by plunging the test specimen under water for a period of one hour, removing the adhering water by blotting paper, and weighing as rapidly as possible. It is apparent that there is an inherent source of error in this experiment, for it is practically impossible to weigh a wet object with great accuracy. By standardizing the conditions and by having all the weighings made by the same individual it is hoped that results have been obtained which are at least relatively correct; but it is admitted that in the case of stones with a very low ratio of absorption the error may be appreciable.

(e) *The ratio of absorption for two hours* was determined by allowing the same specimens used for the one hour test to soak for another hour.

(f) *The ratio of absorption for slow immersion* was determined by the method adopted by Hirschwald.[1]

In this operation a second little cube of about one cubic inch was dried and weighed as in the operation described above; it was then placed in a vessel into which water was allowed to pass at such a rate that the specimen was entirely covered in four hours. The cube was allowed to remain under water for 24 hours and was then weighed and the ratio determined as before. Hirschwald recommends leaving the cube under water until the weight is constant, but for this report it was assumed that the weight had become constant after 24 hours immersion. This slow immersion test is of value with regard to stone placed in structures under water, or in foundations below the ground level.

(g) *The ratio of absorption* obtained by soaking the stone under *reduced pressure* is probably of little practical value in itself, but the figures obtained are of interest when compared with those obtained under other conditions, for they throw some light on the physical structure of the stone and the nature of the pore space. The experiment was performed by subjecting the specimens from the last test to reduced pressure for a period of about 12 hours, after which water was slowly admitted into the containing vessel until the specimens were flooded. After standing for twelve hours under water the specimens were weighed and the ratio of absorption determined as before. The test specimens were placed in a large glass bottle, from which the air was drawn by a water pump capable of a reduction in pressure of about 25 inches of mercury. A little water was kept in the bottom of the bottle to prevent the sucking in of the bottom and to provide aqueous vapour. The bottle itself was placed in another vessel containing warm water; in consequence, the temperature inside the glass bottle was always sufficiently high to keep the water in violent ebullition. It is thought, therefore, that if the pump failed to maintain the reduction in pressure, the presence of the aqueous vapour would prevent any air passing back into the pores of the test pieces.

(h) *The ratio of absorption under pressure* was determined by placing the test pieces from the last experiment in a steel cylinder filled with water and subjecting them to a pressure of about 100 atmospheres for a period of 12 hours. The pressure was obtained from a duplex reciprocating air pump, the compressed air being conveyed to the cylinder through a capillary tube. Recently made distilled water was used in order that no air might be present; it is possible, however, that the water in the cylinder absorbed air from the compressed air used, and in consequence this method of obtaining pressure is not to be recommended. The apparatus was employed because it was the only means available of obtaining a pressure of 100 atmospheres. The figure obtained from this experiment represents the total absorbing power of the stone as far as it can be obtained by mechanical means, and is recorded as the *Ratio of Absorption* in Table I of the appendix. Wherever the expression *Ratio of Absorption* is used without modification it is to be understood as the maximum ratio, determined in the manner described above.

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[1] Handbuch der bautechnischen Gesteinprüfung, p. 112.

The absolute ratio of absorption, or the ratio of absorption under pressure, is given in Table I of the appendix. These figures are roughly proportional to the pore space and require no further general remarks. The comparative tables of ratios of absorption for one hour, two hours, under reduced pressure, and under strong compression, are given in Table II of the appendix. An analysis of this table, in the case of the limestones, shows that the amount of water absorbed in one hour is not greatly increased during the second hour, but that there is nearly always a considerable increase by the slow immersion method. In many cases there is no increase over the slow immersion test by the vacuum process or by strong compression; usually, however, there is a slight increment for each of these operations. The behaviour of the sandstones is more varied. The Sillery stone doubles its amount of water on the second hour's soaking, after which the increase is very gradual. The Beauharnois stone increases gradually through all the operations. The Carboniferous stone from Pointe à Bourdeau makes its greatest gain under the slow immersion test, and also a considerable increase by the vacuum test. The Devonian stone from Gaspé increases noticeably during the second hour, and nearly doubles that content under the slow immersion experiment, whereas the increase is but slight under vacuum and strong compression.

The granites show very little increase by the second hour's soaking, and the increment under the slow immersion and vacuum tests is usually but slight; in most cases, however, there is a considerable increase under the pressure test. In the case of the black granites the increases are very gradual up to the pressure test where the most marked increment occurs.

The marbles show little difference between the one and the two hour periods, but they have a sharp advance under the slow immersion test, after which the increments are very slight, and in many cases absent. The slates seem to increase gradually throughout the whole series of operations.

(i) *The coefficient of saturation* has been fully explained on page 64, Vol. I, and on pp. 4, 5, Vol. II of this report. It may be defined as the ratio between the water absorbed under certain fixed conditions and the total amount of water that the stone is capable of absorbing. The factor is of great value in determining the frost resisting properties of stone, for the injury by frost is due to the pressure exerted by the water on being converted into ice in the pores of the stone. If the pores of the stone are less than 0.9 full there is room for the water to expand and no injury will result, if, on the other hand, the pores are more than 0.9 full, the expansion of the water in passing into ice exerts a pressure whereby a disruption of the particles is effected. A coefficient of saturation of less than 0 9 indicates that theoretically the stone is not in danger from the action of frost. As the pores are not equally filled throughout a test specimen by short soaking it is apparent that this theoretical figure is not exactly in accord with the results of experiments. Hirschwald is of the opinion that 0.8 is to be regarded as the critical figure, and he supports this opinion by more than 1200 examples. According to Hirschwald the *Coefficient of Saturation* is calculated from the ratio of absorption obtained by the slow immersion process. From the practical point of view, therefore, the unmodified expression is applicable to stones that are intended for use under water or in foundations. The coefficients of saturation as tabulated in Table I of the appendix to this report were determined in this manner. In the *Handbuch der bautechnischen Gesteinprüfung* Hirschwald restricts the expression to this determination, but in other publications he employs it with regard to determinations of one or two hours' soaking. In the earlier volumes of this report the coefficient was determined for periods of one or of two hours' soaking, and the same practice is repeated here, with the addition of the slow immersion coefficient as described above. It is not to be understood that Hirschwald has discarded the determinations for periods of one and two hours, but merely that he has restricted the term "Coefficient of Saturation" to the slow immersion test. The same factor is determined for periods of one and two hours, but he prefers to express it as the percentage of the total pore space which becomes filled under the conditions named. As the term has been employed in the earlier volumes of this report for the short period determinations, it seems advisable to retain it; but it is to be understood that in this volume the unmodified expression refers to the slow immersion determination.

(j) *The coefficient of saturation for two hours* is obtained by dividing the amount of water absorbed in two hours by the total amount the stone is capable of containing.

(k) *The coefficient of saturation for slow immersion* is obtained by dividing the amount of water absorbed by the slow immersion process as described under (f) above, by the total amount of water the stone can contain. This factor is the "Coefficient of Saturation" proper.

(l) *The coefficient of saturation* as determined from soaking the test specimens *under reduced pressure* is of little use practically, as this condition of saturation is not reached by material in the walls of a building either above or below ground. The factor may be of value, however, as it indicates certain characteristics of the pore space; in fact, the pore space that is not filled with water during this experiment must be practically sealed.

The coefficient of saturation proper, that is to say, the coefficient obtained by the slow immersion method is to be understood as representing the behaviour of the stone under the worst possible natural conditions, such as beneath water or below the level of the ground. It will be observed that but few of the limestones are immune from the action of frost under these severe conditions. The sandstones show a rather better record, with the figures highly in favour of the Carboniferous stone from Bourdeau. Most of the granites are below the danger line, and all the black granites are immune. The marbles show a bad average, indicating that this class of stone should never be used for underground work. Slates give an average comparing favourably with the black granites. A comparison of the figures in Table II show that all the limestones are safe for ordinary conditions as indicated by the one and the two hours' tests, but that some are much better than others. The sandstones average even better than the limestones. The granites are all below the danger line, but they are not much safer in ordinary walls than below water. On the other hand the black granites, while practically immune even under water, show an increased resisting power under the short immersion tests. The marbles, judged by this test, are the least satisfactory material for outdoor construction, but some of them are apparently well outside the danger zone. Much difficulty was experienced in getting good duplicate results with the marbles, in consequence the figures are less reliable than in the case of other classes of stone.

(m) *The dry crushing strength* determinations were made on the 100 ton Wicksteed hydraulic testing machine at McGill University. The test cubes were prepared with the greatest possible care and presented approximately four square inches on the bearing faces which were ground as plane and parallel as possible. The cubes were crushed between polished, case-hardened steel plates, and were protected from contact with the steel by sheets of blotting paper. Any lack of parallelism in the bearing faces was corrected by an adjustable head on the machine. On the suggestion of Mr. McNab of McGill, the adjustable head was locked when about 2000 lbs. pressure was recorded. At this pressure complete adjustment must have occurred, and it was thought that by allowing the swivel head further play the tendency would be to throw the load on the weaker part of the cube, i.e. on that part of the cube which first began to yield to the compressive strain. Despite every precaution it was found that close duplicate results are not to be obtained, especially at high pressures. In all cases where anomalous or unexpected results were obtained the experiment was repeated.

The crushing strength of the limestones ranges from 15,000 to 44,000 lbs. per sq. in., with an average of about 22,000 lbs. The sandstones range from 15,000 to 31,000 lbs., but too few were tested to give any value to the average. The twelve granites gave an average result of about 30,000 lbs. per sq. in., ranging from 23,000 to 39,000 lbs. per sq. in. The black granites average nearly 39,000 lbs., with a maximum of 45,700 lbs. for the tinguaite (banc rouge) from Montreal. The marbles average 20,000 lbs., and the slates 30,000 lbs. per sq. in.

(n) *The crushing strength of wet samples* was determined on cubes prepared as above and saturated with water by soaking under reduced pressure. The loss of strength which a stone suffers in consequence of being saturated with water is regarded as a good measure of its general durability. Hirschwald arrives at a factor which he calls the "Coefficient of Softening" by means of determinations of tensile strength, but as the preparation of material for this test is very slow and laborious it is hoped that the crushing strength determinations will express the same results. Another reason for adopting this method is that the crushing strength of wet samples is required for comparison with the crushing strength of samples which have been frozen.

The softening effect of soaking in water may be determined by comparing columns one and two of Table IV. It will be observed that the limestones with a clay content, those that are not commonly used for finer construction, show the greatest loss of strength, ranging up to 9,000 lbs. per sq. in. The better grades of stone show, in several instances, no appreciable loss, and none of them exceed about 3,000 lbs. The sandstones show a greater softening, with an average loss of about one-third of their strength.

One of the granites showed a gain of 1,700 lbs. which can be explained only as an instrumental error or as due to a flaw in the test cube. The average loss in strength of the other eleven examples was about 2,500 lbs. per sq. in. The tinguaite from Montreal and the essexites of Mount Johnson are not measurably affected by soaking in water, but the Yamaska stone seems to be more susceptible. The marbles are but little affected with only one exception, which is apparently anomalous.

In the case of the slates these tests are very unsatisfactory, as the making of cubes without cleavage developing is very difficult. Further, the tendency to part on the cleavage planes is increased by soaking, so that glide planes are established which make the results very uncertain.

(o) *The determination of the effect of frost on stone by means of direct experiments* is a very difficult matter and has been fully discussed in the introductory chapter of the second volume of this report. The cubes for this test were prepared as above and were saturated by treatment under reduced pressure, after which they were frozen and thawed forty times by means of artificial cold. They were crushed while still wet in the manner described above. It has already been pointed out in earlier parts of this report that the freezing of artificially saturated stone is much too severe to compare with the natural freezing which takes place in the walls of a building, but, on the other hand, the number of freezings is insignificant compared with the natural freezings that would occur in a period of years in a country of the climate of Canada. The interpretation of the results as indicative of the frost resisting properties of the stone must therefore be made with due regard to the nature of the experiment and the amount and character of the pore space. For instance a stone whose coefficient of saturation for one hour is 1.00 is in no worse condition while undergoing this test than it would be after normal exposure in the wall of a building; on the other hand, a stone whose coefficient of saturation for one hour is 0.5 is loaded with water far beyond its normal content and will suffer injury much in excessof that which would occur under normal circumstances. A direct comparison of the results of the tests is therefore manifestly to the great disadvantage of the latter example. In view of such facts as this it might be argued that the direct experiment is of no value, and that the coeficient of saturation is sufficient guide as to the frost resisting properties, but it must be remembered that the coefficient of saturation indicates only that a stone in which this factor exceeds 0.8 is *liable* to be injured by frost, and takes no account of the ability of the material to *withstand* the disintegrating forces set up. Further, the coefficient of saturation is an expression from which the actual *amount* of water present is eliminated, and therefore can in no way express the *extent* of the probable injury. The direct experiment is therefore of value in that it indicates the extent of the injury to be expected in those stones whose coefficient of saturation exceeds the danger point. As the direct test also furnishes a measure of the ability of the stone to withstand disintegrating mechanical forces it is a guide to the general durability of the material, but care must be exercised in this interpretation also, for the greater the pore space the greater the strain, so that comparisons cannot be made directly, but must be made with due regard to the amount of the pore space. To illustrate the above principles let us imagine three stones, A, B, and C, in which the power of resistance to mechanical strains is equal. Let us ascribe to these examples the properties indicated in the first two columns below, then the loss of strength under the freezing test must occur as indicated in the last column.

	Pore space, per cent.	Coefficient of saturation by slow immersion.	Loss of strength by freezing test.
A	1.00	9	low
B	2.00	8.5	medium.
C	3.00	7	high.

It is apparent, therefore, that with these examples, in which the power of resistance is equal, the loss of strength must be roughly proportional to the percentage of pore space, but C, which suffers the most, is in no danger of injury by frost because its coefficient of saturation is so low that it can never be filled with water to the danger limit under the worst possible natural conditions. On the other hand, A, which suffers the least under the experiment, stands in the greatest danger owing to its high coefficient of saturation. We must look, therefore, to the coefficient of saturation to determine if a given stone is in danger of injury by frost; we may determine from the percentage of pore space the probable relative amount of the injury provided we are comparing stones of the same cohesion, and we must look to the direct test for a measure of the ability of the stone to withstand the strains. Finally, it must be observed that in the case of stones of low porosity and high crushing strength and cohesion, as in the case of the granites, the instrumental difficulties in conducting the crushing strength tests are too great to measure with accuracy the slight differences in strength produced by forty freezings. In defence of the direct test, however, it may be stated that only two anomalous results were obtained in the case of twenty-one limestones, and one anomalous result out of four sandstones; in the case of twelve granites, however, four anomalous results were obtained, but the differences in every case were very small.

The crushing strength after freezing was determined for twenty-one limestones of which nineteen gave results appreciably lower than the wet test. Two of these limestones, however, showed a slight increase over the figure obtained from the wet test. The anomalous result, in one case at least, can be attributed to an unsatisfactory failure of the wet cube. Omitting these two, the average loss in strength of the remaining nineteen examples was 2100 lbs. per sq. in. Selecting twelve stones which are commonly regarded as of the best grade, and omitting certain argillaceous stones which are not used for finer work, as well as one or two examples in which the failures were not perfect, the average loss in strength is 1630 lbs. per sq. in. The fine grained and argillaceous limestones suffer most severely. The twelve selected samples, which are all semi-crystalline Chazy or Trenton limestones, range in loss from 560 lbs. to 2760 lbs. per sq. in. This loss is not proportional to the pore space and must, therefore, be attributed to a difference in the resisting power of the stone. It must also be remembered that the determination of crushing strength at such high pressures cannot be considered accurate to within 500 lbs. at least.

The Sillery and Carboniferous sandstones both show a slight loss which is not at all comparable with the loss by soaking alone: this is in accord with the general conclusion reached in the case of Carboniferous sandstones of the Maritime Provinces.

The Beauharnois stone shows a more severe loss, but I am inclined to think that this may be due to slight flaws in the test cube. The Devonian stone from Causapscal shows a serious gain, the reason for which is not apparent as the wet test was twice repeated in an attempt to remove the anomaly but without success.

Most of the granites and black granites show a slight decrease in strength, but several indicate a slight gain. Allowing for the instrumental variation it may be concluded that the injury effected by forty freezings is not a measurable quantity in the case of these stones.

The white dolomitic crystalline limestone from Portage du Fort shows that neither water or frost has any weakening effect. Both the Missisquoi and the Dominion marbles seem to lose about 1000 lbs. per sq. in. under the freezing test.

(p) *The transverse strength* was determined from slabs of the stone which were approximately one inch by two inches in cross section. The stratified rocks were cut parallel to the bedding, and the igneous rocks parallel to the rift with the long diagonal corresponding to the grain as far as could be determined. The transverse section therefore represents the head or hardway, making the figures recorded the maximum for the material in question. The tests were made on the Olson machine in the engineering laboratory of the University of Toronto.

The transverse strength of the limestones varies from 2118 to 4550 lbs. per sq. in. and averages about 3000 lbs. The strongest stones in this respect are the fine grained black and argillaceous varieties. The sandstones show considerable variation, ranging from 2740 lbs. in the Sillery stone to 913 lbs. in the Carboniferous stone from the Restigouche. The strongest granite shows 4935 lbs. and the weakest 1360 lbs. The average of eleven examples is less than in the case of the limestones, being only 2442 lbs. per sq. in.

The tinguaite from Montreal is so filled with checks that the determination is not reliable; the Mount Johnson stone averages 2822 lbs., and the Yamaska mountain type gives 1745 lbs.

The yellow marble of the Dominion Marble Company is much the strongest in this respect, showing 3115 lbs. per sq. in. The Missisquoi marbles average about 2000 lbs.; while the white stone from Portage du Fort is much weaker, owing probably to its coarse grain, and gives a transverse strength of 1238 lbs.

The only fresh slate procurable was that from the quarries at New Rockland, which gave the highest result of any stone tested 13,125 lbs. Several other slates were tested with much lower results, but as they were all obtained from old dumps or from surface material the results are of little or no value.

(q) The shorter broken ends of the slabs from the transverse tests were employed for the *shearing tests*. The operations were conducted by Mr. R. Marshall of the University of Toronto, who devised the necessary apparatus from the description given by Hirschwald in "Der Handbuch der bautechnischen Gesteinprüfung." Mr. Marshall describes the instrument and the manner in which he conducted the operations in the following terms:—"The base of the apparatus consisted of a broad steel plate, 1¾ in. thick, 6 in. wide and 9 in. long. The end of this plate and the upper or bearing face were planed smooth in order to give a sharp square shearing edge. For the purpose of holding the test specimen firmly against the base a holding bar was bolted on by two three-quarter inch bolts. This bar was made of three-quarter inch steel plate, three inches wide and five inches long, and was so placed that one edge was in the same vertical plane as the shearing end of the base. The shearing knife was made of high grade three-quarter inch steel, three inches wide and six inches long. The bearing edge was bevelled down to a width of two millimetres.

"The specimen to be tested was firmly bolted to the base by means of the holding bar, leaving about one inch overhanging the shearing edge. The base was then placed on the bed of an Olson wire testing machine of 20,000 lbs. capacity. The shearing knife was then carefully adjusted to insure a true shearing plane and the load applied by hand."

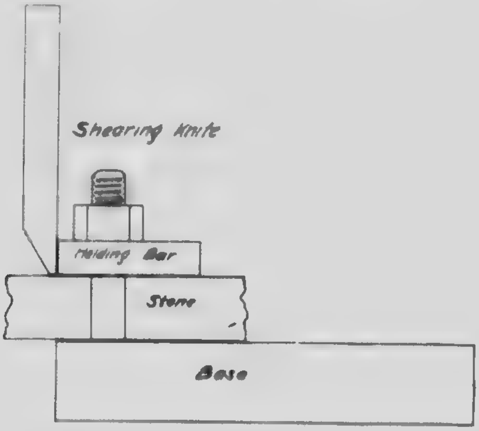


FIG. 1. Apparatus used in making shearing strength tests.

The shearing strength of twenty-one limestones averages 2000 lbs. per sq. in. and is, therefore, about two-thirds of the transverse strength. The two factors were equal in the case of several stones, more particularly the fine grained argillaceous examples. The proportion between the two sets of results varies from 1 : 1 to 1 : 2.4, with an average as stated above of 1 : 1.5.

The shearing strength of the granites averages 1800 lbs. per sq. in. The proportion between the shearing and transverse strengths is therefore 1 : 1.3. This proportion was more uniformly shown than in the case of the limestones.

In the case of five black granites the average shearing strength was found to be 2150 lbs., while the transverse strength of the same examples was 2560 lbs. The proportion therefore is 1 : 1.2.

The Portage du Fort stone shows a shearing strength of 1200 lbs. which is but slightly less than the transverse strength: all the other marbles show a shearing strength which is little more than half the transverse strength. The shearing strength of the slates is considerably less than half the transverse strength.

(r) *The corrosion test* was made on the one inch cubes which had already been employed for the short immersion experiments for ratio of absorption. The cubes were measured and thoroughly dried as before. After being weighed they were suspended by silk threads in a large bottle. The bottle was filled with water into which carbonic acid gas and oxygen were allowed to bubble constantly. The water was renewed once a week and the operation allowed to continue for four weeks. The cubes were then removed, washed in distilled water, rubbed gently with the finger tips, dried and weighed. The loss or gain in weight serves as a measure of the effect of the weather, while the changes in colour which the specimens suffered is believed to indicate with fair accuracy the influence of atmospheric agencies over long periods of time.

The loss of weight suffered by the limestones on corrosion is less than in the case of the Ontario limestones: this is probably due to the presence of oxygen, which was not used in the tests on Ontario stone. It would appear that the corrosive action of carbonic acid is checked by the presence of oxygen. The change in weight of the igneous rocks is very slight, and in view of the handling which the specimens necessarily undergo it is questionable if such small differences can be accurately determined.

(s) *The drilling test* was devised in order to obtain a factor which would represent the comparative ease with which the different samples could be dressed. The apparatus employed has already been described and figured: briefly the operation consisted in allowing an half inch [illegible] bitted drill to sink into the stone for a period of thirty seconds. The drill was pressed down by a weight of 12½ lbs. and was actuated by a Barre pneumatic tool acting under 60 lbs. air pressure. The depth of the hole in millimetres is recorded directly as the *Drilling Factor.* The results of the experiments were very satisfactory, as the variation in duplicates was always within reasonable limits. While I believe that the figures obtained from the experiments are approximately correct, I am not prepared to say that they really represent in a comparative way the ease with which the different stones can be worked. The figures given express the comparative efficiency of a certain type of drilling apparatus; the reader must draw his own conclusions as to how far the results represent the ease of working the stones.

(t) This test, like the preceding, was devised to obtain a factor expressing the ease of working the different types of stone. The experiment was conducted by allowing a three-quarter inch chisel driven by a pneumatic tool to act on the surface of a slab of stone for ten seconds. The chisel was weighted down by 12½ lbs. and inclined at an angle of 54½. The slab of stone was moved against the chisel through a distance of three inches during the ten seconds of the operation. The loss of weight in grams is recorded directly as the *Chiselling Factor.*

As a scientific experiment the chiselling test is not nearly as satisfactory as the drilling test, for duplicate results vary considerably. This variation is largely due to the irregularity with which chips are thrown out from the sides of the chisel track. The figures, therefore, do not represent the actual cutting power of the tool, but they do roughly represent in a comparative way the general reduction of the surface which is effected. In order that the figures may be intelligently interpreted they must be read with due regard to the accompanying notes as given in Table VII of the appendix to this report. It is apparent from this table that the drilling and the chiselling factors are not in accord, but I believe that they both express properties of the stones which will be found of advantage in forming a general conception of the ease of working. The type of chisel used in these experiments was found to give so low a result in the case of the harder stones like the granites, that the test was not applied to stones of this kind.

CHAPTER II.

AN OUTLINE OF THE GEOLOGY OF THE PROVINCE OF QUEBEC FROM THE POINT OF VIEW OF THE BUILDING STONE INDUSTRY.

The most ancient rocks that compose the crust of the earth consist of a series of gneisses, granites, and other crystalline rocks, intermingled in places with sedimentary materials which have likewise become crystalline through metamorphic agencies. This crystalline complex forms the axis or backbone of all the continents, and on its flanks have been deposited the sedimentary rocks which have greatly increased the original extent of the continents. This ancient series is usually referred to as the *Pre-Cambrian;* it is also known as the *Archæan*, and has been called the *Azoic* in reference to the fact that no life is known to have existed on the globe during the vast period of time during which these rocks were formed. With the exception of a narrow strip extending along the north shore of the St. Lawrence, with a maximum width of about 30 miles to the northward of Montreal, the whole of the great northern region of the province is composed of crystalline rocks of Pre-Cambrian age. The greater extent of this country is formed of rough gneisses and gneissoid granites, which are not suitable for fine construction but which are hard and durable stones for ordinary purposes. In certain parts of the area, more particularly from Pontiac county eastward to Montcalm, a subdivision of the Pre-Cambrian, known as the *Grenville* series, is met with in belts having a general northeasterly direction. The rocks consist of gneisses, schists, and crystalline limestones, often associated with pyroxenic rocks of igneous origin. This series yields marble at many points on the crystalline limestone bands, particularly at Portage du Fort in Pontiac county, in the Augmentation of Mille Iles, and at Ste. Thècle in Champlain county. The Grenville series is also the source of the mica, apatite, and graphite of the region north of Ottawa, and it is in association with these rocks that occur the serpentine bands and some of the eruptive dykes of porphyry which may have a future value as decorative stones.

The great Pre-Cambrian area has been cut by many intrusive rocks of igneous origin, principally granite, diabase, and anorthosite. The granites form large masses in Argenteuil and at Rigaud mountain in Vaudreuil. They have been worked for building stone at both these localities. A great granitic mass also occurs in Berthier and Maskinongé, but there are no quarries now being worked in this region. Smaller, but perhaps more valuable masses of granite occur east of the Rivière à Pierre and near Roberval, as well as in many other localities. The dark basic rocks, such as diabase and diorite, occur in the form of dykes throughout the region. Whatever their possibilities may be, none of these stones are at present being quarried for purposes of construction. The anorthosites form large masses of a characteristic dark purplish colour. The greatest area is in Terrebonne and Montcalm, but smaller masses occur at a number of points to the eastward.

South of the St. Lawrence river the Pre-Cambrian rocks appear as narrow belts running northeast and southwest. There are three main ridges, in which the rocks are largely of igneous origin and consist of greenstones, porphyries, and altered sediments. The chief material quarried from the Pre-Cambrian in this area is the marble of the Dominion Marble Co. at South Stukely. It is possible, however, that some of the igneous rocks may yield decorative material of value.

Following the Pre-Cambrian came a long period of many millions of years during which the oceanic waters successively invaded and retreated from the area which is now the southern part of the Province of Quebec. During this age, which is known as the *Palæozoic* on account of the fact that a very ancient and extinct type of life existed, the flanks of the old Pre-Cambrian axis were gradually covered by a series of sedimentary rocks. By the close of Palæozoic time the rock formations of the Province of Quebec were completed, for although other ages succeeded in the history of the globe, this part of the world was never again under water, and in consequence has received no further additions.

In describing the Palæozoic rocks of the province it will be necessary to exclude the region east of a line between Lake Champlain and Quebec city for a reason that will appear later. The following description, therefore, applies to the region between the Pre-Cambrian of the north and the International boundary west of Lake Champlain. It is apparent that many changes must have occurred during the Palæozoic era, and that these changes must have left evidence whereby the rocks may be divided into *systems*, and these systems further subdivided into *formations*. From the oldest to the youngest the systems of the Palæozoic are as follows: Cambrian, Ordovician, Silurian, Devonian, and Carboniferous. In the part of Quebec under discussion the only systems of importance are the Cambrian, Ordovician, and Silurian.

The Cambrian System:—During Cambrian time the ancient ocean advanced on the Pre-Cambrian axis and its waves beat into sand the fragments of the old rocks which they encountered. In consequence, a fringe of sandstone marked the strand line of the advancing sea, while in the deeper water was deposited the finer material, which consisted chiefly of suspended particles of clay. The maximum advance of the Cambrian ocean is still indicated by a fringe of sandstone extending along the Pre-Cambrian boundary north of the St. Lawrence river, occupying a greater extent in Vaudreuil, Soulanges, Beauharnois, and stretching southward to the boundary of the province. This formation marks the top of the Cambrian system and is commonly known as the *Potsdam*, but I have preferred to designate it as *Potsdam-Beekmantown* from the fact that it passes by insensible gradations into the next succeeding formation. This sandstone is mostly hard and white, frequently even flinty in character: it has been quarried for building purposes at many points, more particularly, Beauharnois, Lachute, and Papineauville.

The Ordovician system:– The base of this system consists of the formation known as the *Beekmantown*, which was formerly designated the *Calciferous*. The rocks are mostly rough, brownish, dolomitic limestones, frequently filled with cavities containing secondary crystals. The lower part of the formation is often very sandy and passes insensibly into the underlying Potsdam. The rocks are found in very limited amount south of the Potsdam-Beekmantown fringe north of the St. Lawrence, where they have been quarried for building and for flagstones in the vicinity of St. Jerome. The formation has a considerable development in Two Mountains, and also in Beauharnois and southwards to the boundary. Quarries have been operated on this stone for canal construction, but its rough character and the readiness with which it weathers do not recommend it for structural purposes and no quarries are now being worked. The latter part of Beekmantown time probably witnessed a withdrawal of the sea from the continental area, as the next succeeding formation, the *Chazy*, is always sharply defined from the underlying Beekmantown. The deposition of the Chazy rocks marks a second oceanic advance, which in this part of the country did not extend as far as the previous invasion. The Chazy rocks consist chiefly of shales and limestones, the latter being formed largely from the broken fragments of calcareous shells and other parts of organisms which abounded in the seas of the time. As many of these fossil fragments are of crystalline character, particularly the stems of sea-lilies, the [illegible] grades of Chazy limestone present a semi-crystalline structure. The formation is developed chiefly on Ile Jesus, on part of Montreal island, near Caughnawaga, in the vicinity of Grande Ligne, and at St. Dominique. The areas are not extensive, but they yield some of the finest limestones quarried in the province, more particularly at Cap. St. Martin on Ile Jesus.

The Chazy is followed by several formations which may be designated the *Trenton series*, and which are grouped together as they are not very sharply defined one from another: they were probably deposited during the same oceanic advance. These formations in ascending order are the Lowville (Birdseye), Black River and Trenton. The Lowville stone is generally very compact and of whitish colour marked with little specks (birdseyes) which represent the remains of a characteristic fossil. This rock is not of frequent occurrence in the province, but the lower beds of the quarries at Pointe Claire belong to this formation.

The Black River stone is usually heavy-bedded and dark coloured with wavy bituminous partings: it frequently presents two types of stone – a fine grained dark non-fossiliferous variety, interbanded with a lighter, semi-crystalline fossiliferous type which is almost indistinguishable from the Trenton limestone. The Trenton formation as developed in the Province of Quebec presents two general types of stone—a light coloured, semi-crystalline variety much prized as a building material, and a harder, dark and thinner bedded variety which is adapted only to rough building and for use as crushed stone. The Trenton and Black River rocks form a large part of Montreal island and Ile Jesus, whence they stretch eastward in a belt of considerable width to beyond the city of Quebec. Both varieties of Trenton stone are quarried on Montreal island and Ile Jesus, as well as at various points along the north shore, particularly at St. Marc des Carrières in Portneuf county. Below Quebec, as at Beauport and Château Richer, only the dark and thin-bedded type is seen. Rocks of this age are not extensively developed south of the St. Lawrence, but some areas occur from which excellent stone is quarried: the best known of these smaller areas is that in the vicinity of the city of St. Johns. The *Utica* and *Lorraine* (*Hudson River*) formations, which succeed the Trenton series, consist of shales and thin-bedded limestones which are not adapted for use as building stone. A considerable area of Utica rock lies between the St. Lawrence at Montreal and the head of Missisquoi bay on Lake Champlain. Eastward of this belt the country is largely occupied by Lorraine rocks as far as the previously mentioned line between Lake Champlain and Quebec. The Ordovician comes to an end as far as this region is concerned with the close of the Lorraine stage, and likewise the Palæozoic history of this part of the province.

The line between Lake Champlain and Quebec, and thence down the St. Lawrence river, indicates the approximate position of a great break or fault in the earth's crust, which separates the comparatively level western area from the rougher and more mountainous region of the east. In the nature of its rocks and in its geological structure this eastern portion of the province belongs to the Appalachian mountain system, of which it represents the northeast extension.

"Geologically the Appalachian region of Canada is characterized by a very complicated structure. The strata, chiefly of Palæozoic age, at various times and over large tracts, have been greatly disturbed, traversed by many faults, and now lie in highly inclined positions. During earlier Palæozoic times, embayments of the sea spread over the region in question, alternately expanding and contracting, while frequently these bodies of water seem to have taken the form of long, wide sounds, extending in a general southwesterly direction, sometimes to join the great interior sea that flooded the central portions of the continent. In these embayments were deposited great volumes of sediments, which, during intervals of emergence, were eroded, and folded and faulted during successive periods of activity of mountain building forces. Over considerable districts intrusive areas of igneous rocks occur, and geological history is further complicated by the local presence of volcanic material."[1]

[1] Geol. Sur. Can., Rep. No. 1085, p. 32, 1909.

The elevated ridges of Pre-Cambrian rocks which form the axes of this region are disposed in three roughly parallel anticlines stretching in a north-easterly direction. The most westerly ridge is known as the Sutton, and is separated from the second by a broad valley about 25 miles wide. The second ridge is the Stoke mountain anticline, and is followed by the Megantic range farther east. These Pre-Cambrian elevations are not so apparent to the southward of Quebec, but they reappear in the Shickshock mountains of Gaspé. Lying between these ridges and partially folded in with them by subsequent earth movements are accumulations of sediment which represent practically the whole Palæozoic series.

The Cambrian: The Cambrian strata cover a large part of eastern Quebec and stretch in a broad belt from the extremity of Gaspé to the Vermont border. The lower part of the Cambrian seems to be represented by extensive developments of slates which have been quarried at many places in the Eastern Townships, more particularly in Melbourne Slates also occur in Temiscouata county, where a quarry has recently been opened.

A series of red and green shales, with interbanded sandstones, constitutes the Sillery formation, and has long been regarded as of upper Cambrian age, although recent investigations suggest that it may be more properly ascribed to the Beekmantown. This formation covers a very extensive area in the region south and east of Quebec. The present interest in this formation is confined entirely to the sandstones which have been quarried in the vicinity of Quebec and Levis.

Lower Ordovician strata occur in a broad belt along the Maine boundary and also in bands squeezed in between the Cambrian rocks at a number of points. The one important subdivision from the present point of view is the Phillipsburg series from which the Missisquoi marbles are quarried. These rocks are metamorphosed limestones which are probably to be ascribed to the Chazy formation.

Silurian strata are represented by narrow bands belonging to different formations. The metamorphic limestones of Dudswell and Lime Ridge, as well as the flagstones of Bishops Crossing, are of Silurian age. Extensive Silurian strata also occur in Gaspé, and have been quarried near Port Daniel, on the Intercolonial railway near Millstream, and at other point .

Devonian rocks are of very limited occurrence in the Eastern Townships, but a belt of shales and sandstones about six miles wide extends from the Intercolonial railway near Causapscal to the extremity of the Gaspé peninsula, a distance of 150 miles. The sandstones of this formation are of a desirable character and will probably come into more general use as the country is opened up.

The Carboniferous system is but feebly represented in Quebec, as rocks of this age appear only along the north shore of the Baie des Chaleurs. An olive-green sandstone of this age is quarried at Pointe à Bourdeau on the Restigouche river opposite Campbellton, N.B.

The metamorphic area of eastern Quebec, as well as the Palæozoic plain of the southwestern part of the province, has been broken by extensive intrusions of igneous rocks at different times in geological history. Three general types of rocks are represented in these intrusions basic rocks such as peridotites and diabases, granites, and varieties of essexite.

The basic intrusions occur along the southeastern side of the Sutton Pre-Cambrian anticline between the Chaudière river and the Vermont boundary west of Lake Memphremagog. These rocks are for the most part dark coloured and of unattractive appearance, but some varieties in Orford mountain and elsewhere might be employed as "black granite." In many places the rock has been converted into serpentine, and in the vicinity of Black Lake, Thetford, and Danville the serpentine is accompanied by veins of silky, fibrous asbestos, which has made the Province of Quebec famous as a producer of that material. The serpentine of the asbestos region is dark and so excessively shattered that little hope is entertained of its possibilities as a decorative stone. Farther east, however, in Melbourne, and again in Orford mountain, the serpentine is of better colour, less cut by asbestos veinlets, and gives greater promise as a decorative stone.

Extensive granitic intrusions, all of which have yielded good building stone, occur in the Big and Little Megantic mountains, at Stanhope on the international boundary, in Stanstead county, and at other less important points.

At a still later date, probably in late Devonian time, the Palæozoic plain of the western part of the province was invaded by the remarkable series of igneous rocks, which now constitute the Monteregian hills and form conspicuous elevated points in an otherwise level country. These hills are seven in number, and reach from Mount Royal on Montreal island to Brome mountain in the township of Brome. The rocks are largely of the essexite family and are quarried for building and decorative purposes, more particularly on Mount Johnson and Shefford and Brome mountains.

At a comparatively recent date in geological history occurred the remarkable event known as the Ice Age, during which the whole of Canada was swept by enormous glaciers which did much to modify the topography of the country. In their resistless march from the north these glaciers bore immense quantities of boulders of the crystalline Pre-Cambrian rocks far to the southward. With the coming of warmer climate and the consequent retreat of the ice, these boulders were left in great numbers over the surface of the country. Where local stone is not available these field stones or "hardheads" are extensively employed for building purposes. At Rivière du Loup, at many towns and villages in the Chaudière valley, and generally over the region covered by the soft shales of the Sillery formation, advantage is taken of the profusion of field stones, and they are employed for many structures of architectural importance.

CHAPTER III.

LIMESTONES OF THE PROVINCE OF QUEBEC.

The limestones quarried in the province of Quebec for purposes of construction are obtained to a very large extent from the Chazy and Trenton formations. Beekmantown stone is employed locally, and the limestone of Silurian age in the peninsula of Gaspé is used in very limited amount.

All the finer grades of structural limestone are derived from the Chazy or Trenton formations and from the point of view of this report are very similar in their physical properties. They are all semi-crystalline, greyish stones in which the chief variation is the relative development of thin, dark-coloured, argillaceous partings. The presence of these partings determines to a very large extent the suitability of the stone for buildings of the better type, and likewise constitutes a measure of their durability under the action of the weather. The tendency of the dark partings to yield to atmospheric agencies soon causes a block in which they are present in large amount to present a streaked and somewhat dirty appearance.

A second type of stone, more common in the Trenton than in the Chazy, is a more thinly bedded, less crystalline and much darker stone, which is suitable for rock-face work and for buildings of a common character. Stone of this type accompanies the better grades in many of the large quarries near Montreal and Hull, and constitutes the whole of the available stone at the quarries at Beauport and Château Richer below the city of Quebec.

Beekmantown limestone as developed in the province is usually of poor colour and does not present possibilities beyond a local application for foundations, etc. It is quarried to a very small extent near Beauharnois, St. Jerome, and Portage du Fort (?).

The Silurian limestones of Gaspé are heavily bedded and are much disfigured by an excess of clayey partings which result unfortunately on weathering; they are employed for building at Causapscal and at other points along the line of the Intercolonial railway.

The metamorphosed Palæozoic limestones of Phillipsburg, Dudswell, and Port Daniel are employed for building purposes, but as they are really marbles their description will be found under that head. The same is true of the Pre-Cambrian crystalline limestones of South Stukely and Portage du Fort.

Dolomitic and porous limestones of the type of the Niagara and Guelph stones of Ontario are found in the province of Quebec only on Burnt island in Lake Timiskaming. The extremely fine grained, almost lithographic stone of the Lowville, and the somewhat similar type from the Black River of Ontario, has been observed only in the upper beds at St. Dominique, and in the quarries at Pointe Claire, which are not now being worked for building stone.

Limestones of the Chazy and Trenton Formations.

Owing to the similarity of the limestone from these two formations it is thought advisable to describe them together. The Trenton is to be understood as comprising the Black River, although stone of this formation is of limited amount as compared with the true Trenton.

For convenience of description the following geographic areas, certain of which are subdivided into districts, may be recognized in the province of Quebec:

- Montreal area.
  - Montreal district.
    - Villeray group.
    - Mile End group.
    - De Lorimier group.
    - Iberville group.
    - Nicolet group.
    - Maisonneuve group.
    - Côte St. Michel group.
    - Lachine group.
  - Caughnawaga district.
  - Pointe Claire district.
  - St. Laurent district.
  - Bordeaux district.
  - St. Martin district.
  - St. Vincent de Paul district.
  - St. Francois de Salles district.
- St. Johns Grande Ligne area.
- St. Dominique area.
- Joliette area.
- St. Cuthbert area.
- St. Marc des Carrières area.
- Grenville area.
- Hull area.
- Roberval area.

MONTREAL AREA.

The Chazy, Lowville, Black river, and Trenton limestones have been very extensively quarried on the island of Montreal, on Ile Jesus, and on the south shore of the St. Lawrence at Caughnawaga. Most of the important quarries are in either the Chazy or Trenton beds. The stone from all these quarries may be classed under two heads, with a third intermediate type.

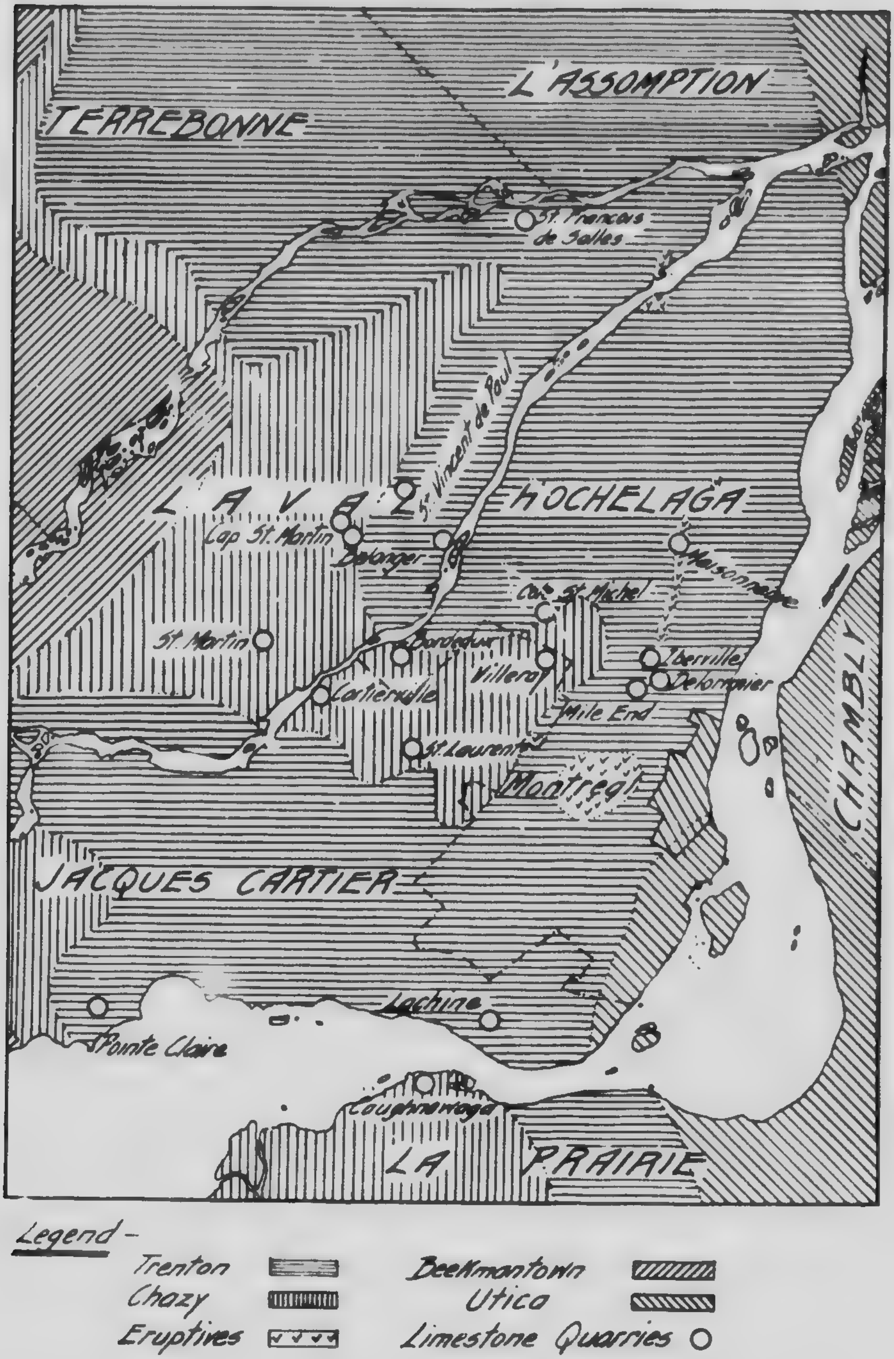


FIG. 2. Sketch map of Montreal and vicinity, showing the chief quarry districts.

1 A high grade, semi-crystalline, grey limestone varying chiefly in the degree to which shaly partings are developed. This stone is used mostly for cut work but it is also employed in rock-face work for buildings of the highest grade.

2 A dark, fine grained, thin bedded limestone used for foundations and to a limited extent for rock-face work.

3 —An intermediate type used for rock-face work in many buildings which are trimmed with the high grade stone. Much of this stone is the culled portion of the high grade beds.

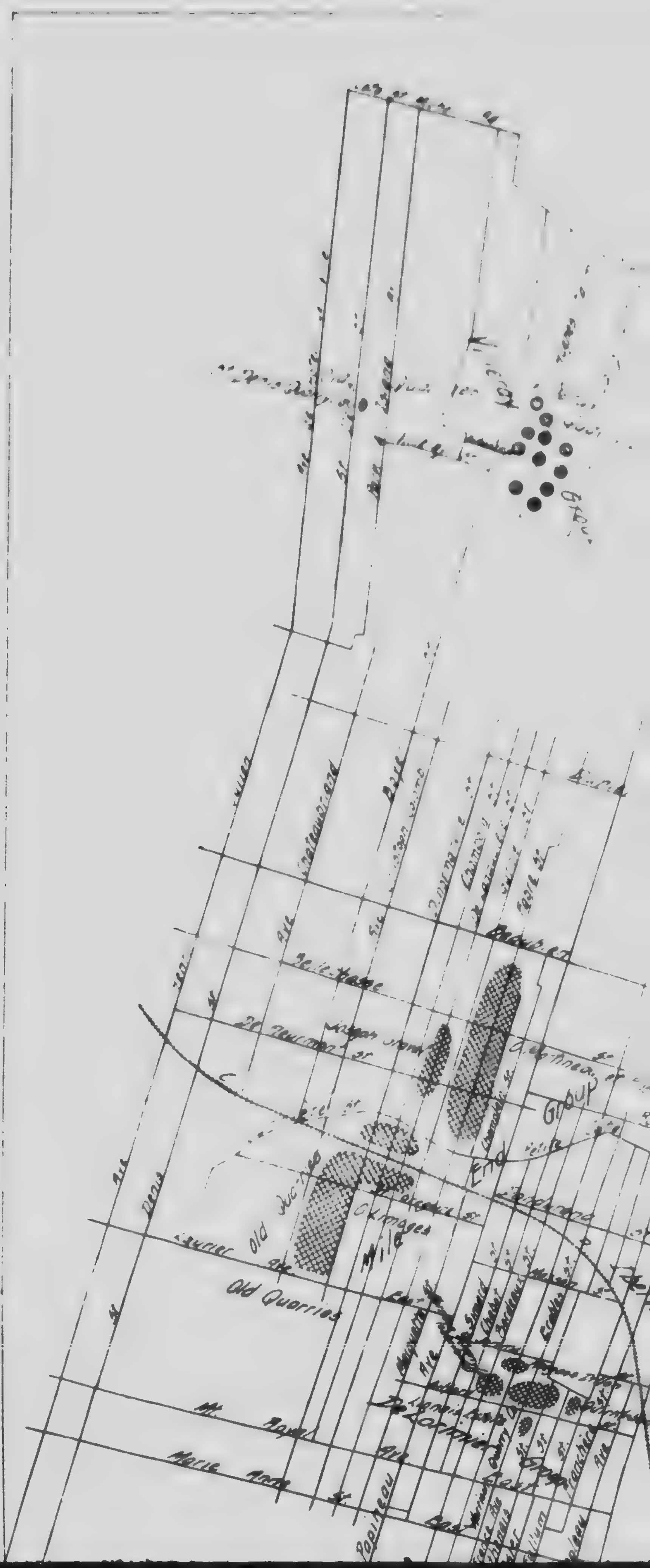
The present production of high grade building stone within the limits of the city of Montreal is much less than that of earlier years owing to the extension of the city and the increasing overburden. At the present time, stone of this type is being produced from only two places Martineau's quarry north of Carrière street and the Villeray quarries. Buildings now being erected in Montreal are forced to employ stone in increasing quantities from quarries in the Montreal area outside the city. The inferior type of stone suitable only for rubble and rough work is still produced in quantity, but most of the product is converted into crushed stone.

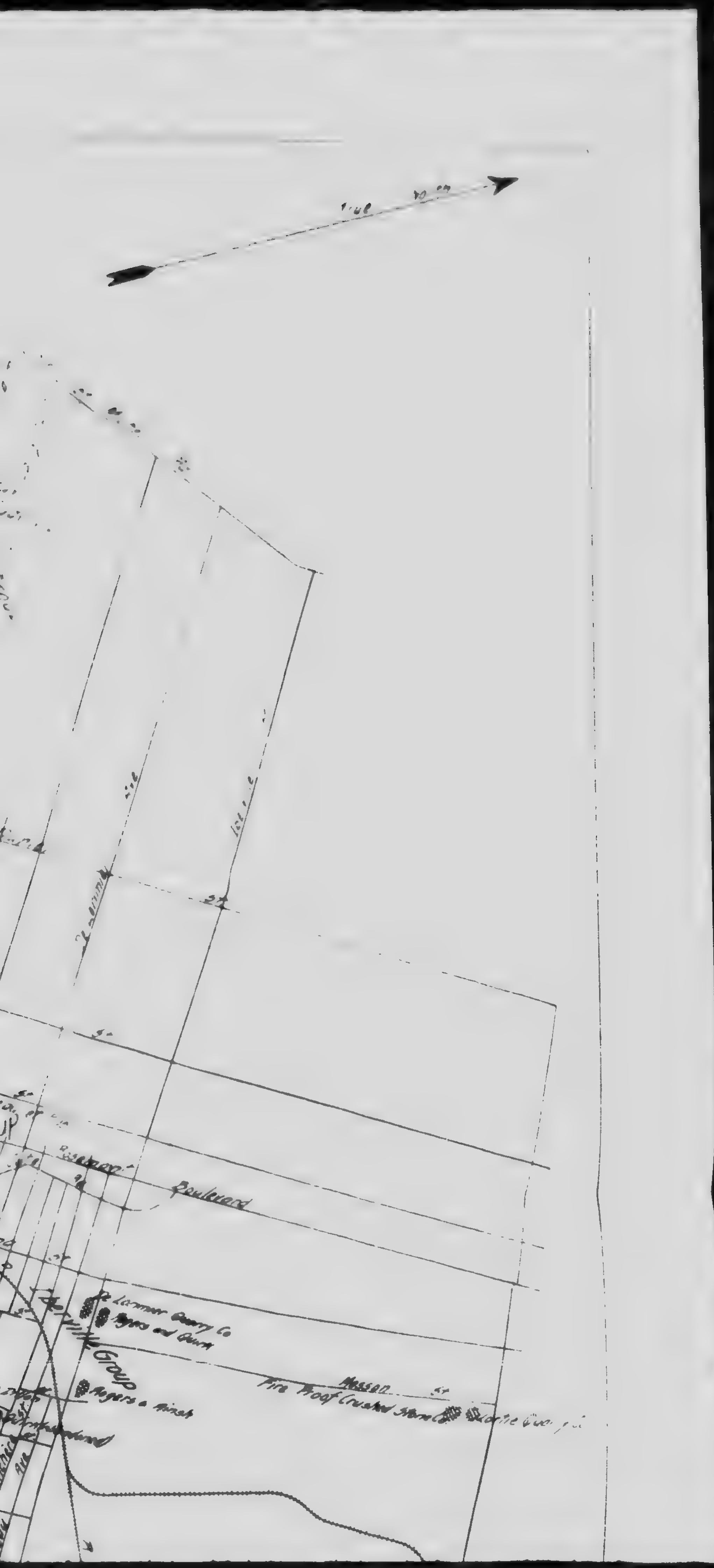
The similarity of the stone from the different quarries in the area and the practice of using stone from different localities in the same building make it somewhat difficult to obtain data as to the wearing ability of the product of an individual quarry.

The use of the high grade stone in buildings of a monumental type in Montreal has been so universal that little need be said except with regard to the durability of the stone. When freshly bush-hammered, Montreal stone presents a much lighter appearance than the rock-face. In the course of time this difference becomes less pronounced. Considerable diversity is to be noted in the resistance to the weather of different blocks; the degree of resistance seems to be directly related to the amount of shaly partings in the stone. This feature is well shown in Plate V.

In store fronts and in dwelling houses of the middle class, it is a very common practice to use 12 inch blocks of high grade stone for the corners and to lay up the rock-face coursing in two 6 inch courses or in two courses of 5 and 7 inches each (Scotch work). In many buildings the coursing stone is the inferior type of dark coloured stone, the use of which enhances the contrast between the bushed corners, sills, etc., and the rock-face coursing. This dark stone weathers much more rapidly than the better grade of stone, and assumes a lighter colour with a rather dirty appearance. In course of time the contrast between the different grades of stone and between the bush hammered and rock-face work becomes less pronounced. (Plate IV).

The Aberdeen school on St. Denis street shows well the loss in contrast between the bushed and rock-face work in the high grade stone. In new buildings the point finish is frequently employed to give a colour effect intermediate between that of the hammered work and the rock-face. (Plate VI).

Group
End
Old
Mile
Old Quarries
Laurier Ave
Denis
Ave
St
Mt. Royal Ave
Marie Anne St
Papineau
Ave


Boulevard
Larmer Quarry Co
Rogers and Gourn
Group
Rogers & Hinch
Masson
Fire Proof Crushed Stone Co
Ave

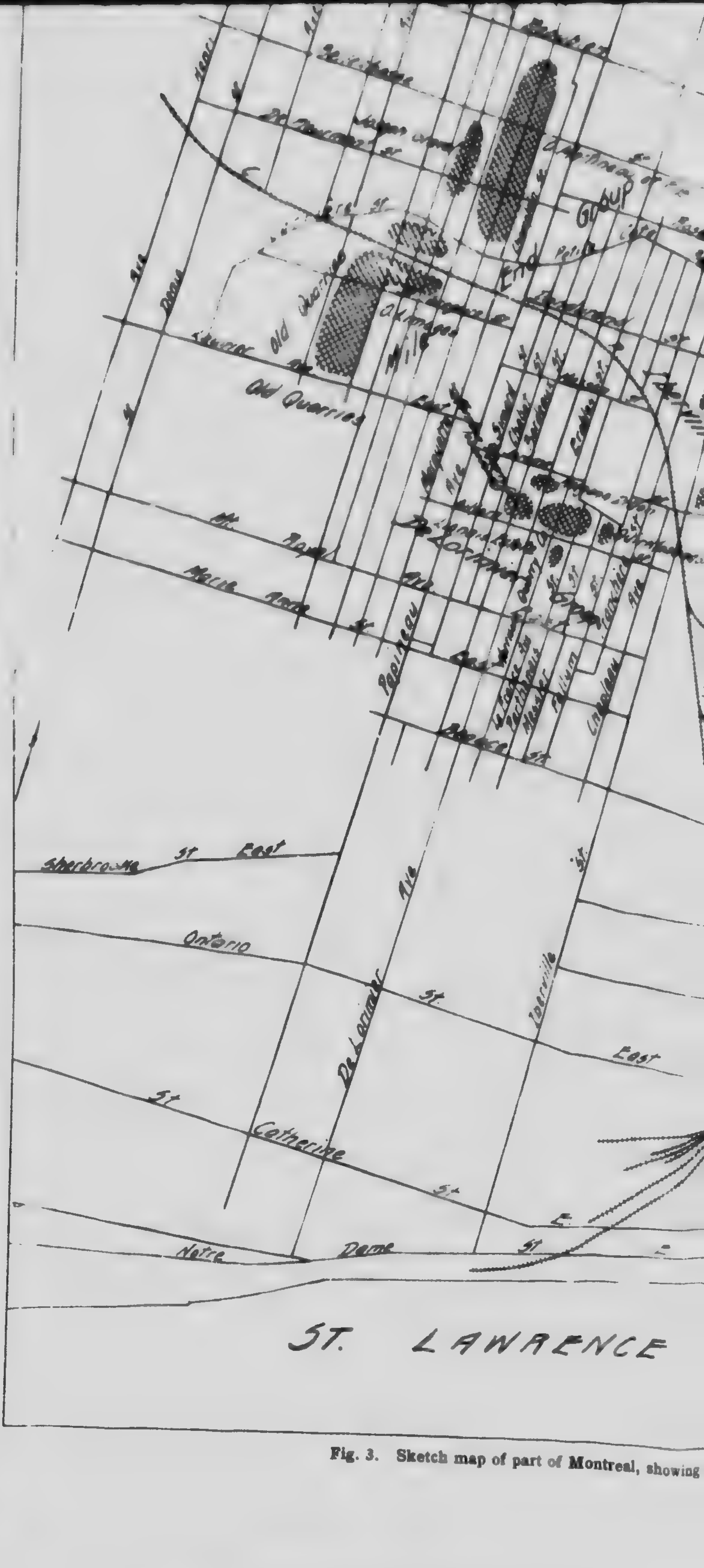
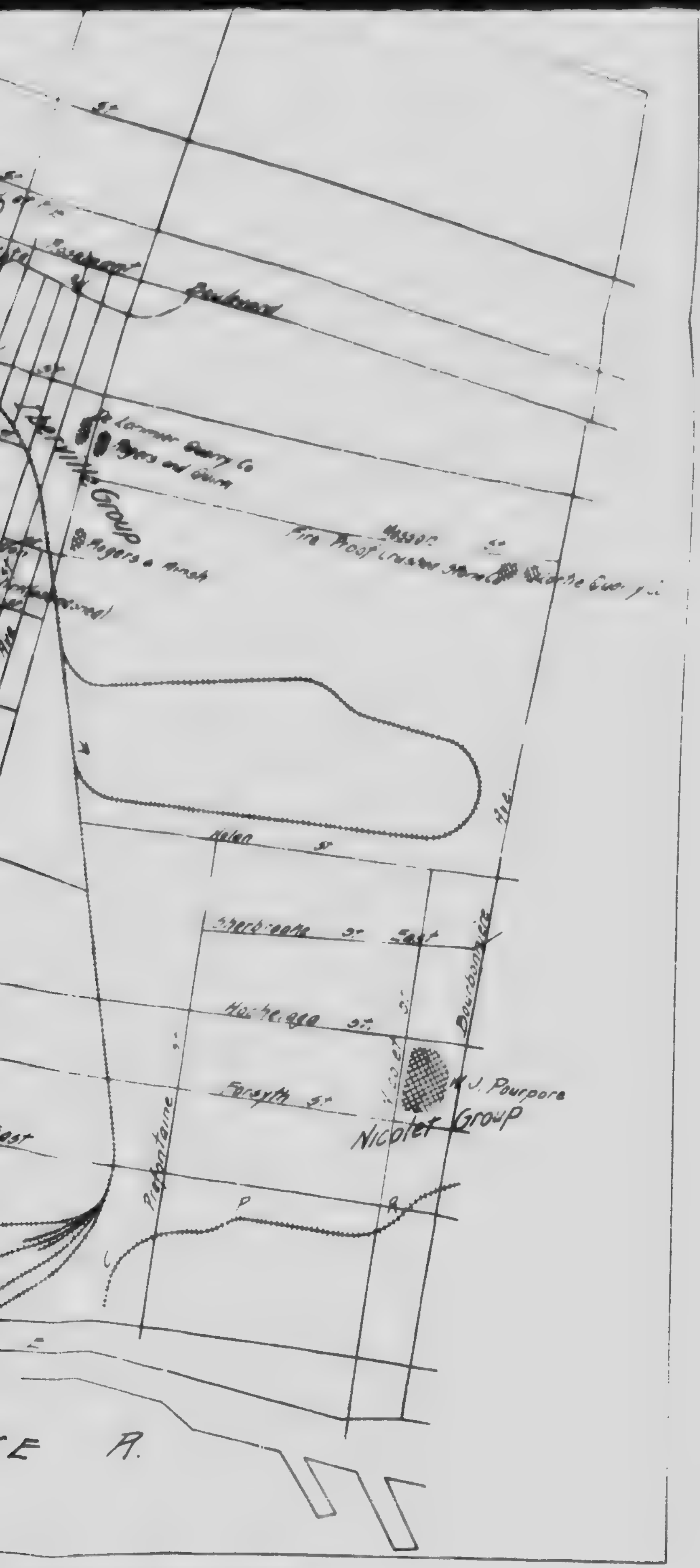


Fig. 3. Sketch map of part of Montreal, showing



l, showing the chief groups of quarries.

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MONTREAL DISTRICT.[1]

The limestone quarries within or close to the city limits of Montreal do not now produce the quantity of building stone that was formerly obtained from them. Of the old Mile End quarries the only one now yielding high grade stone is that of O. Martineau et Fils north of Carrière street. The other source of production is the quarry, or rather series of quarries operated by the Villeray Quarry Co.

The quarries within the city of Montreal may be conveniently grouped as below:—

Villeray group.
Mile End group.
De Lorimier group.
Iberville group.
Nicolet group.
Maisonneuve group.
Côte St. Michel group.
Lachine group.

VILLERAY GROUP

This group of quarries in St. Denis ward is now confined to a restricted rea on the undivided land of the Hughes and Jarry estates to the east f the terminations of Du Rosaire and Villeray streets. Formerly quarries xtended westward from this locality to Alice street and southward to the orner of St. Laurent and Molière streets. Old quarries east of Lannes treet and along both sides of Casgrain street show that the Villeray group as formerly practically continuous with the Papineau avenue quarries.

The excavations in the Villeray district have been made along the ummit of a minor ridge and have not been extended to a great depth. In general way it may be said that about 12 feet of good stone lies close to e surface along the ridge and that the increasing overburden away from e axis of the elevation renders the cost of extraction prohibitive.

The Villeray Quarry Co., John P. Dixon, president, 848 Du Rosaire reet, Montreal.

The properties controlled by this company are the only ones of the oup now producing building stone; they consist of about 150 acres on the ith end of the Hughes and Jarry estates lying to the east of Boyer street.

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[1] The streets in Montreal do not correspond in direction with the cardinal points of compass. St. Catherine street is called east and west and St. Laurent north and south. s practice is adhered to in this report although it is far from correct. "North" is northt and "east" is northeast. Where readings are given in degrees they are magnetic, ther statements of direction are to be interpreted as above.

The quarries have been opened at a number of points in which the succession of beds is somewhat different. The stripping varies from nothing to 3 feet, and the stone is of good quality from the surface. A typical section shows beds in thicknesses of 1 ft., 14 inches, 2 feet, and 16 inches. Below this level the stone is said to be blue and hard. In places the beds coalesce and much thicker stone may be procured. The most pronounced system of joints runs E. 20° S., with clean vertical partings at intervals of about 7 feet. A second set occurs at right angles to the above but it is less regularly developed. Stone of any reasonable size may easily be obtained. All the product is of building quality, but two grades may be recognized—a coarser grained stone (588) which is considered the most desirable, and a finer type (589) which is also a good building material. Some of the stone is rendered less desirable on account of showing an interbanding of the two varieties, or on account of the presence of fine veinlets of white calcite.

The stone: No. 588.—This example is a brownish grey, semi-crystalline limestone of medium to fine grain. The grain is considerably finer than in the St. Marc stone, and it is also somewhat finer than the average good stone from the quarries in the city of Montreal. The colour and grain may be seen in Plate L, No. 9. The stone is composed largely of fragments of calcareous fossils, many of which are of crystalline character; these are cemented in a calcareous matrix which shows in places minute spherical concretions of calcite. On treatment with carbonic acid and oxygen, the colour becomes much lighter and the bluish aspect of the ground surface is lost. The general matrix is light in colour and is marked by round dark spots where the little oolitic calcite concretions occur. The fossils appear partly as whitish lines and partly as darker specks where their crystalline character is more pronounced.

The physical characteristics are as follows:—

Specific gravity	2.712
Weight per cubic foot, lbs.	168.633
Pore space, per cent	0.394
Ratio of absorption, per cent, one hour	0.0978
" " " " " two hours	0.108
" " " " " slow immersion	0.1325
" " " " " in vacuo	0.1392
" " " " " under pressure	0.1456
Coefficient of saturation, one hour	.67
" " " two hours	.743
" " " slow immersion	.91
" " " in vacuo	.957
Crushing strength, lbs. per sq. in., dry	21,610.
" " " " " " wet	20,500.
" " " " " " wet after freezing	18,260.

Transverse strength, lbs. per sq. in.	2,637.
Shearing strength, lbs. per sq. in.	1,100.
Loss on corrosion, grams per sq. in.	0.02582
Drilling factor, mm.	18.
Chiselling factor, grams	5.9

Analysis by H. A. Leverin, Mines Branch Laboratory:

	per cent.
Insoluble matter	1.10
Ferric oxide and alumina	.50
Calcium oxide	52.65 equivalent to 90.02 per cent carbonate of lime.
Magnesium oxide	1.18 equivalent to 2.46 per cent carbonate of magnesia.

No. 589.—This example shows in part a stone which is similar to No. 588 but of finer grain. Interbanded with this type, however, is a much finer grained variety, somewhat lighter in colour but otherwise closely resembling the fine grained stone from Hull shown in Plate L, No. 16.

It will be observed, therefore, that the product of the quarries gives a selected stone of medium grain, but there is a considerable amount of finer grained and more variable material interbanded with the better variety.

The quarrying is done by individual operators to whom the company grants rights on restricted portions of the property. As these operators are more or less independent of the company the names of those at present engaged are given below:

Joseph Charboneau.
Joseph Lapierre.
Albert Cousineau.
Joseph Faucet.
Joseph Morin.
Pierre Gugeon.
Jean Vallade.
Martin Gagnon.
Alfred Crevier.
Godmaire Paysan.
H. Lauzon.
Gustave Gagnon.
J. B. Presseau.

The company handles the waste stone for rubble and acts as agent for the various operators in disposing of the cut stone. Each of the operators has one or two derricks and the company operates six of its own.

Cut ashlar, rock-face, is valued at 90 cents per sq. ft. and rock-face sills at 75 cents per running foot at the quarry. Curb stones, 20 in. by 6 in., are quoted at 50 cents per foot in large orders and at 55 cents for smaller orders.

Rubble is valued at 70 cents per ton, f.o.b. cars at siding. In 1912 the cut stone produced was valued at $52,000 and the rubble at $50,000. A comparison of the above figures with those furnished by the company in 1911 show that the price of cut stone has advanced and that the price of rubble and curbs has remained practically the same.

These quarries are to be regarded as the principal source of the rock-face shoddy so largely used for coursing in Montreal.

Dixon and Gagnon, No. 848 Du Rosaire St., Montreal.

This company obtains stone from the same operators that supply the Villeray Quarry Co. Unlike that company it deals in cut stone only, and is at present engaged in making curbs, of which it is expected that 180,000 feet will be produced during 1913.

St. Denis Quarry Co., Bruneau, Brault and Co., St. Denis St., Montreal.

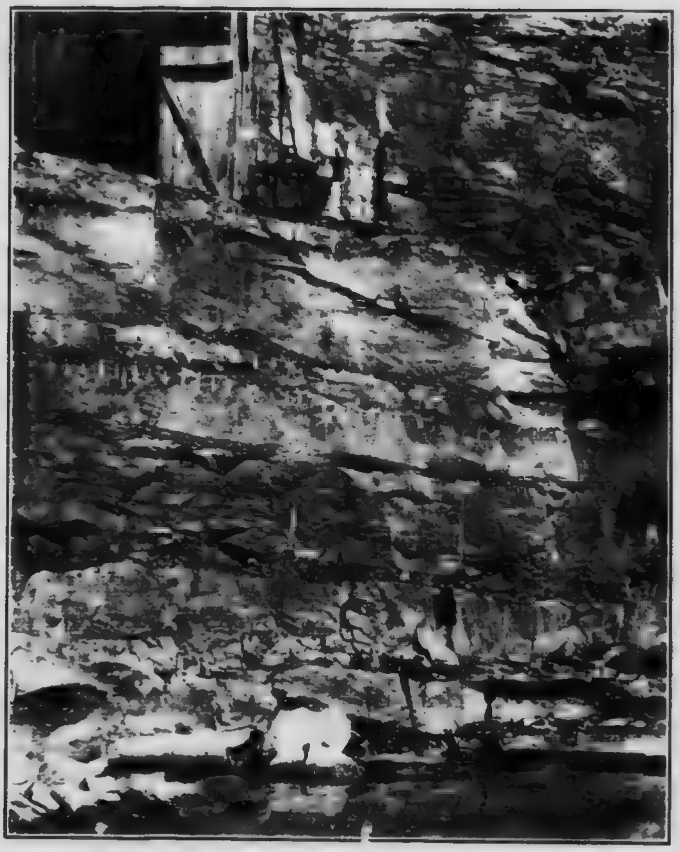
The lands extending from Boyer street westward on the north side of Villeray street have been quarried over for building stone with a consequent production of a large amount of debris. The St. Denis company controls a strip of land about 800 feet long extending 240 feet east, and 100 feet west of St. Denis street. The beds are similar to those already described on the property of the Villeray Quarry Co., but in places the excavations are 12 feet deep showing stone in beds up to 18 inches or even 2 feet in thickness.

The company has installed a small crusher and is engaged in working the old piles of debris. No quarrying is being done at the present time. Ten men are employed and about 150 tons of crushed stone are produced a day.

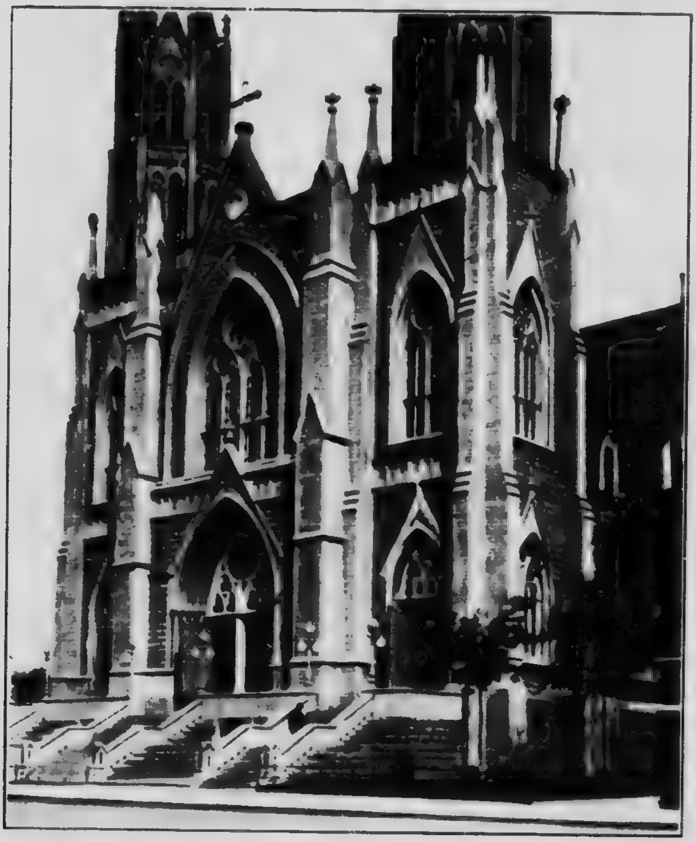
The stone is similar to that of the Villeray Quarry Co. described as Nos. 588 and 589, pages 30 and 31.

MILE END GROUP.

The area bounded by Mount Royal avenue, Papineau avenue and Beaubien street, to the south, east and north respectively, and more irregularly to the west by a line reaching almost to St. Denis street may be regarded as a quarrying area in the Trenton formation from which immense amounts of stone have been removed in the past. Most of the old quarries have long been abandoned, chiefly because the stone had been removed over the entire property controlled by the owner to a depth beyond which profitable quarrying was impossible. Many of the older quarries, particularly in the vicinity of St. Denis street, have been filled in and built on. This region has produced a large portion of the high grade Montreal limestone, and at present it shares with the Villeray group the distinction of yielding the only cut stone within the city limits.



Montreal limestone. Martineau's quarry, Mile End group, Montreal.



Montreal limestone, Martineau's quarry. St. Edouard church, St. Denis St., Montreal.

O. Martineau et Fils, operators, 371 Marie Anne St., Montreal;
T. A. Morrison and Co., selling agents, 204 St. James St., Montreal.

This property occupies the area between Carrière, Garnier, and Marquette streets and extends north almost to Beaubien street. It contains 30 acres in all, most of which has been quarried. At the south end of the property adjoining Carrière street about 50 yards still remain throughout the whole thickness of the section, but a considerably greater area of the good building beds which occur towards the bottom of the section still remain. The section varies in different parts of the quarry; the figures for two measurements are given below:

Stripping—Variable, heavy at east end, average 5 feet.
35 ft.—Thin bedded, black and grey, bastard limestone.
3 ft.—Solid grey building bed, sometimes divided.
1 ft.—Solid grey building bed, sometimes divided.
3 ft.—Grey limestone but somewhat seamy.
1 ft.—Good grey building bed.
1 ft.—Good grey building bed.
2 ft.—Solid bed but of less desirable character owing to variations in grain and colour.

The second section is:—
35 ft.—Thin bedded, black and grey bastard limestone.
2 ft. 6 in.—Solid grey building bed.
2 ft. 3 in.—Thinner, black-banded stone.
1 ft. 2 in.—Good building bed.
3 ft. 10 in.—Thinner, black-banded stone but with good layers in places.
5 ft.—Good heavy stone, in places solid, but generally separated into three beds by wavy black partings.

These lower beds are practically horizontal and are cut by two main series of joints, the first running N. 25°E. with a dip of 70° to the northwest, and the second running E. 5°S. vertically. The spacing of both sets is so wide that no difficulty is experienced in obtaining large pieces; blocks 12 to 15 feet long and 5 feet wide have been quarried. The excavation in the building beds is of less extent than in the upper beds and the face is now advancing southwards at a distance of 500 feet behind the similarly advancing face in the upper layers. The heavy beds are quarried by the use of quarry bar and air drill, little if any explosive being used. (Plate II).

The stone: No. 584.—In general it may be said that the desirability of Montreal limestone, as between different examples, lies in the degree to which clay seams are developed in the stone. Observations on old buildings show that the stone, in some cases, has retained an homogeneous appearance, while in others the effect of the weather is very noticeable in the etching out of the clayey laminations. (Plate V). The present example is a carefully selected specimen of the best stone, in which no lamination is apparent.

This stone is shown in Plate I., No. 12: it is slightly darker in colour and considerably coarser in grain than the Villeray stone described as No. 588 on page 30. The smoothed surfaces of the two stones are very similar, but the present example is slightly more blue. On being corroded with carbonic acid and water, the blue colour is lost and the sample assumes a whitish-grey and speckled appearance of coarser aspect than that presented by the Villeray stone. An examination with a lens shows large crystalline fragments and numerous whitish specks which are the remains of fossil *Bryozoa*. The minute oolitic concretions seen in the Villeray stone are much less abundant.

The physical properties are as follows:

Specific gravity	2.707
Weight per cubic foot, lbs.	168.022
Pore space, per cent	0.455
Ratio of absorption, per cent, one hour (average)	0.0832
" " " two hours (average)	0.0955
" " " slow immersion (average)	0.1270
" " " in vacuo (average)	0.1259
" " " under pressure (average)	0.1482
Coefficient of saturation, one hour (average)	.562
" " two hours (average)	.688
" " slow immersion (average)	.909
" " in vacuo	1.00
Crushing strength, lbs. per sq. in., dry	22,400
" " " " " wet	20,430
" " " " " wet after freezing	17,870
Transverse strength, lbs. per sq. in.	2,118
Shearing strength, lbs. per sq. in.	1,630
Loss on corrosion, grams per sq. in.	.02712
Drilling factor, mm	14.3
Chiselling factor, grams	5.4

An analysis by Leverin gives:

	per cent.	
Insoluble matter	00.46	
Ferric oxide and alumina	00.46	
Calcium oxide	54.30	equivalent to 96.96 per cent carbonate of lime.
Magnesium oxide	00.42	" " 0.87 per cent carbonate of magnesia

Montreal limestone. Buildings in Montreal showing the contrast between rock face and bush hammered work.

Montreal limestone. Building in Montreal showing the effect of weathering.

The equipment may be summarized under three heads as below:—

Quarrying plant.

One 20 h.p. boiler.
Two compressors, one driven by steam the other by electricity.
Six hand derricks, one steam derrick, one horse derrick.
One quarry bar.
Two air-drills Canadian Rand.
One pump driven by electricity.

Crushing plant.

Two Austin No. 6 crushers and accessories.
One Champion No. 5 crusher with accessories.
Total capacity 500 tons a day.

The mill.

Building 200 ft. by 40 ft., with an L 50 ft. by 40 ft. for the compressor plant.
Travelling 20 ton crane by Anderson, running the length of the mill.
Cutting shed, 120 feet by 60 feet, with 5 ton crane.
Cutting shed 100 ft. by 40 ft., with offices above.
Two diamond saws, Anderson, Montreal.
Two diamond saws, Anderson, Newark, N.J.,
One diamond saw, Pollard Manufacturing Co., Niagara Falls, Ont.,
One planer, Patch.
One lathe, Patch.
Six pneumatic plug drills.
One motor for saws.

In all about 300 h.p. of electrical power is used.

The men employed are as follows:

25 men, quarrying on rough upper beds,
20 men, quarrying on building beds,
70 stone cutters and mill men (maximum),
5 men in connexion with crusher.

The production of cut stone in 1910 was 12,000 cu. ft. and in 1912 the output was valued at $80,000.

The prices quoted are as follows:

Roughly squared blocks, 40 cts. per cu. ft., quarry; 50 cts. per cu. ft. delivered in Montreal. Selected stone is quoted higher.

Sills, 8 in., rock-face or sawn, 70 cts. per ft.

Cut ashlar, bushed or rock-face, 65 cts. per sq. ft., delivered.

The company is now cutting stone for the splendid Maisonneuve market. The product of the quarry may also be seen in the Engineers' club; the Bank of Ottawa, Park ave.; and in St. Edouard church at the corner of St. Denis and Beaubien streets. (Plate III).

In this latter building the rock-face work is marred by black skins in places and by the occasional presence of blocks with muddy streaks. The hammered stone shows scattered imperfections in the form of wavy dark lines and an occasional pluck. On the whole this building is a very creditable example illustrating the exclusive use of stone from Martineau's quarry.

Joseph Gravel, 488 Duluth Street E., Montreal.

This property lies immediately to the west of that described above and has been largely quarried over to a depth of about 15 feet in the upper thin beds. The quarry is now being extended to the south and east towards Chambord street. Old quarries occupy an extensive area south from here and across the railway to the Limoges quarry, which will be described later. The thin upper stone has been removed for the most part, but a large supply of building stone lies under the present floor of the quarry. At present only the upper stone is taken and it is all crushed. Twelve men are employed and a small crusher operated by steam power is at work.

The quarries of the Mile End group extend through old workings south and east to below Laurier avenue. From the present point of view only one other quarry is of importance, that of Olivier Limoges, but the Montreal City Corporation operates for crushed stone to the west of Limoges.

Olivier Limoges, corner of Laurier Ave. and Dufferin St., Montreal.

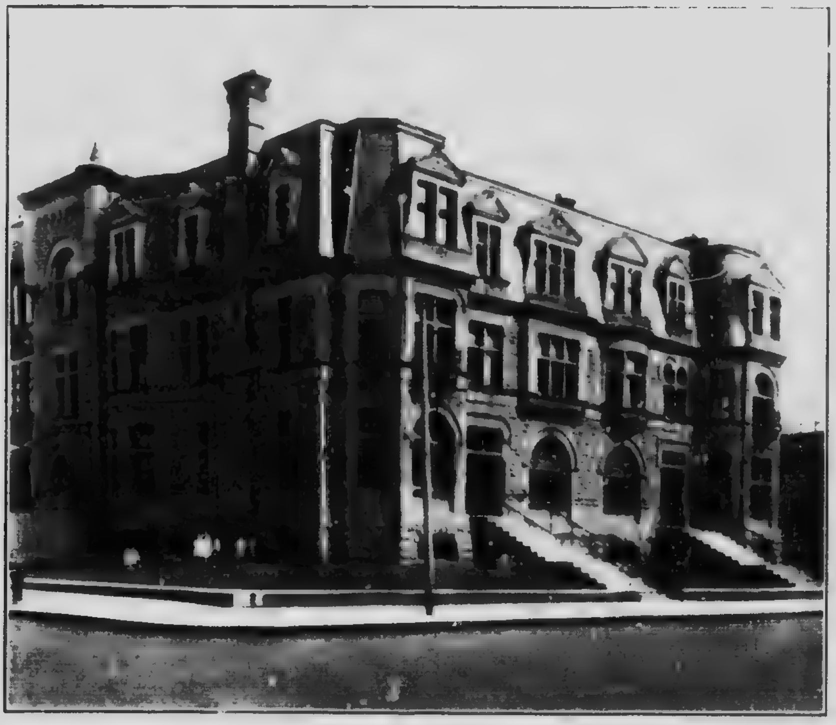
The property consists of a considerable area bounded by Brebeuf, Dauphin and Carrière streets and Laurier avenue. There is also a northeast wing extending across Chambord street to Garnier street. A large portion of this property has been quarried over, particularly with regard to the upper stone. At present, the extraction of the building stone is being prosecuted along the eastern face and it will soon be removed to the street line. In the northeast wing both sets of beds are being exploited.

The face shows from 20 to 25 feet of thin bedded, bastard stone, beneath which the building beds are exposed to a depth of 10 feet as below :—

3 ft. Heavy building stone.
15 in. Thin and shaly material with a 6 in. bed of good stone.
1 ft. Good building bed.
3 ft. Thin bedded, but contains much good stone.
18 in. Good solid bed.

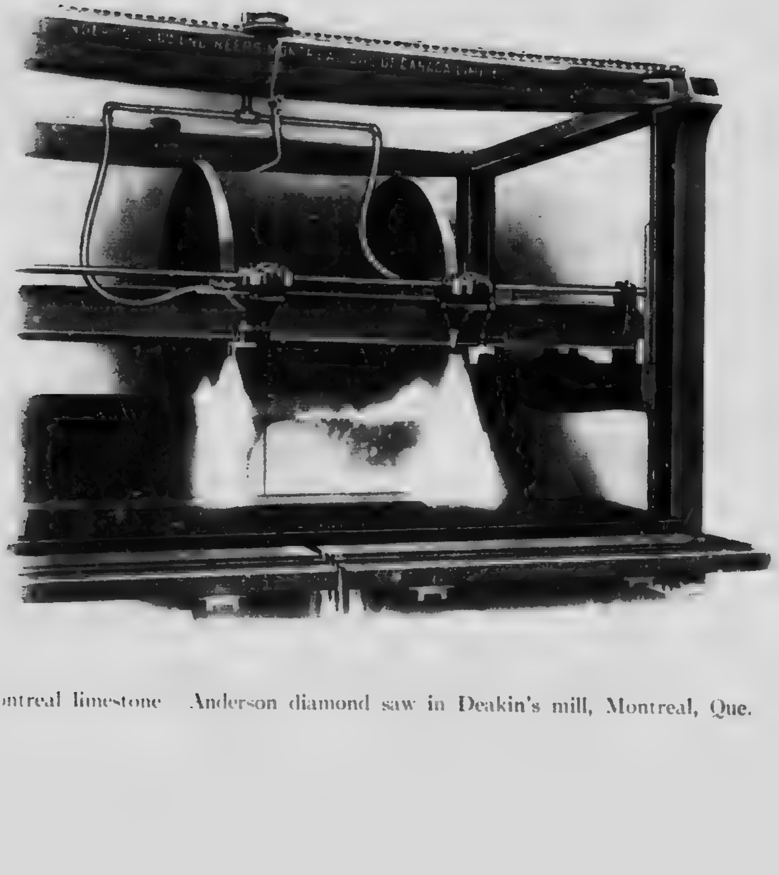
These lower beds show a major set of joints varying in direction from 70° to 80° east of north. A second set is present at approximately right angles to the former but it is very irregularly developed.

The stone: No. 585.—This stone in grain and structure is very similar to No. 584 from Martineau's quarry but it is of a much lighter colour, even lighter than No. 1 of Plate L. The sample shows an extremely uniform grain without any trace of dark banding or shaly partings.



Montreal limestone. Aberdeen School, Montreal, showing the uniformity of colour produced by weathering on rock face and bush hammered work.

PLATE VII.



Montreal limestone Anderson diamond saw in Deakin's mill, Montreal, Que.

An analysis by Leverin gave:—

	per cent.	
Insoluble matter	1.30	
Ferric oxide and alumina	0.44	
Calcium oxide	53.00	equivalent to 94.64 per cent carbonate of lime.
Magnesium oxide	0.62	equivalent to 1.26 per cent carbonate of magnesia.

The operations are conducted for building stone chiefly but a small crusher is maintained to dispose of the refuse. Ten or twelve hand and horse derricks are in position. An electrically driven compressor is employed to furnish air to two rock drills and to two plug drills.

Roughly squared blocks are valued at 45 cents per cubic foot in the quarry.

At the time of a second visit to this quarry in 1913 operations had been suspended.

Montreal City Corporation.

The city's operations are entirely for crushed stone and in consequence do not fall properly within the scope of this work. The corporation controls a strip of land west of Joseph Gravel and also west and south of Limoges to beyond Laurier avenue.

THE DE LORIMIER GROUP.

At the head of DeLorimier avenue, the Trenton limestones are thinly covered and quarry lands occupy the area between St. Jerome street on the north, Chabot street on the west, Fallum street on the east, and a line some distance north of Mount Royal avenue on the south. The northern and western portion of this block is the property of the Wilder estate, while the southeastern portion belongs to the Lionais estate. Three companies conduct quarrying operations, paying a royalty to the owners. In all these quarries the character of the rock and the manner of occurrence is the same; in consequence, a description of one quarry only is given. It should be noted also that two very different types of stone occur here a hard black limestone and an igneous rock, tinguaite, known locally as "banc rouge." In order to preserve the system adopted in this report, these quarries must be referred to again in the chapter on igneous rocks, but the general description will not be repeated.

Morrison Quarry Co., O. Martineau et Fils, operators, 371 Marie Anne St. T. A. Morrison and Co., selling agents, 204 St. James St., Montreal.

The lands leased by this company from the Lionais estate lie between Messier, Gilford, and Des Erables streets and extend north 365 feet almost to the boundary of De Lorimier park. The lease will expire on Dec. 31, 1913. The quarry as described below extends beyond this property into the square between Des Erables and De Lorimier streets.

The quarry is roughly 500 by 200 feet in extent. The depth is about 20 feet. The formation presents two distinct members, the upper layer consisting of the volcanic rock, tinguaite, and the lower layers of hard black Trenton limestone. These lower beds strike N. 25°E. and dip at a low angle to the southeast. The limestone occurs in beds from 2 to 12 inches thick, which are separated by shaly bands. The heavier beds on fresh fracture appear homogeneous, but weathering usually reveals the presence of shaly matter dividing the stone into thinner layers. The formation is rather seriously fractured, the major joints running N. 35°W. and N. 10°E.

The mass of igneous rock which overlaid the limestone when the quarry was opened has been removed over the area of the present opening, but it may be seen for the whole height of the 20 feet of working face at the southeast angle. Farther to the southeast, the igneous sheet is overlain by limestones similar to those below, and it is therefore to be regarded as a sill intruded between the layers of limestone. The intrusive origin of the rock is further attested by the presence of a dyke which runs in an east and west direction across the floor of the quarry. Operations for limestone are now being conducted by working back, i.e., northward, while the main quarry is advancing south and east in the overlying banc rouge. (See No. 581, page 173).

The stone: No. 580b.—This stone is very fine grained, hard and black; its colour is like Nos. 3 or 6 of Plate LI, and the grain like the stone from Beauport shown in No. 1, of the same plate; it frequently shows little stringers of pyrite, and that mineral is common on the joint faces. The weathering properties are not good, as the high clay content and the presence of pyrite cause a rapid alteration to ensue on exposure. This example has not been examined in detail as these beds are not used for building purposes at the present time. In the past, however, considerable quantities of this type of stone have been employed for general building purposes. The whole output of this quarry is crushed for macadam or concrete. The character of the stone is well shown by the following analysis by Leverin:

	per cent.	
Insoluble matter	13.20	
Ferric oxide and alumina . .	3.22	
Calcium oxide.	43.05	equivalent to 76.87 per cent carbonate of lime.
Magnesium oxide.	1.76	equivalent to 3.64 per cent carbonate of magnesia.

The physical properties are probably like those of the similar stone from Beauport described as No. 574 on page 96.

The plant consists of the following machinery:
One 150 h.p. boiler and engine,
Four crushers; three No. 5 Champion, one small Sturtevant.
Two 30 h.p. boilers for drills.
Three Canadian Rand drills.

A second opening on the Lionais estate was formerly operated by the Morrison Company but it is now abandoned,. This opening lies west of the large quarry between De Lorimier avenue and Chabot streets.

Keegan and Dillon, 40 Hospital Street, Montreal.

This company operates on the western part of the block of land referred to as containing the present group of quarries. The structural features of the formation and the character of the stone are the same as in Martineau's quarry.

The plant consists of the following machinery:
One Gates No. 5 crusher.
One electric motor,
One 15 h.p. boiler,
One Canadian Rand drill.

Formerly a considerable output of building stone of a rough type was obtained here, but the business has fallen to 3,000 or 4,000 tons a year. On the other hand the output of crushed stone has greatly increased. Rough stone is quoted at 50 cents per ton, loaded in the quarry.

Lionais Limited, 42 Jacques Cartier Street, Montreal.

A quarry formerly operated by the Dominion Quarry Co. has reverted to the Lionais estate and is now being worked by the owners. This excavation is situated between Des Erables and Parthenais streets immediately south of Gilford street. As in the quarries already described both black limestone and "banc rouge" are produced. The plant consists of one Gates No. 4 crusher, one motor, one boiler, and one steam drill. The product is all crushed.

A fifth quarry in the group was formerly operated by Rogers and Quirk but it is now abandoned. It lies between Messier and Fullum streets to the east of Morrison's large opening.

IBERVILLE GROUP.

A group of quarries in the Trenton limestone, the characteristics of which are very similar to those of the De Lorimier group, is situated at the head of Iberville avenue, a short distance north of the Canadian Pacific Railway line to Bordeaux. To the east of Iberville avenue, Rogers and Quirk are operating, and to the west the De Lorimier Quarry Co.

Rogers and Quirk, 1701 Iberville Avenue, Montreal.

This company has two openings on the estate of Henry Ogan. The southern quarry is on a lower level than the northern one and is about a quarter of a mile distant; it differs also in that both black limestone and "banc rouge" are present, while the northern opening is in greyish bedded stone (bastard).

The southern quarry is about 300 by 200 feet in extent and shows "banc rouge" (No. 582, p. 174) at the top to a depth varying from 5 to 15 feet. Beneath the "banc rouge," black, thin-bedded limestones have been excavated to a depth of 15 feet. This stone is quite comparable with that described under the Morrison Quarry Co., page 38.

A three foot dyke of the eruptive crosses the quarry, N. 30 E. A little rough building stone has been obtained here, but the output is at present all sent to the crusher.

The northern quarry is about 300 by 200 feet in extent and has reached a depth of 20 feet. The upper stone is thin and shaly with numerous fossils; the lower beds consist of layers of grey limestone, separated by clay partings. The material is mostly thin and banded with the black variety, but, by selection, good stone from 8 to 10 inches thick may be obtained (583). The formation strikes N. 10 E. and dips at a lower angle, E. 10° S. A clear set of joints runs N. 40° W. with a dip of 60° to the southwest; another set runs N. 35° E. and has an average dip of 80° to the northwest. The inclination of both sets varies considerably, and films of crystalline white calcite are common on the joint faces.

The stone: No. 583. This example is described in full as being typical of the thin-bedded grey stone, which is known locally as "bastard" probably because it is intermediate between the black stone and the good, thick-bedded grey limestone.

The general appearance of this example is well shown in plate LI, No. 2. Two elements are distinctly seen a dark fine grained portion, in which are occasional large crystals, and a lighter coloured part varying from fine to medium grain: this latter part is fossiliferous and crystalline, resembling No. 584 but it is considerably finer in grain. The dark portion has a high clay content and closely resembles the black stone from Morrison's quarry described on page 38.

On smoothed surfaces the crystalline portion shows the bluish colour characteristic of these limestones while the dark portion is sharply defined by its deep brownish colour. On corrosion the blue part becomes whitish brown, flecked with still lighter flakes: the dark portion is not much changed in colour but it appears more pronounced by contrast with the whitened crystalline portion.

The physical characteristics are as follow

Specific gravity	2.726
Weight per cubic foot, lbs.	168.26

Pore space, per cent	0.78
Ratio of absorption, per cent, one hour	0.1651
" " " " " two hours	0.1985
" " " " " slow immersion	0.2625
" " " " " in vacuo	0.289
" " " " " under pressure	0.289
Coefficient of saturation, one hour	.572
" " " two hours	.688
" " " slow immersion	.908
" " " in vacuo	1.00
Crushing strength lbs. per sq. in., dry	24,350
" " " " " " wet	19,330
" " " " " " wet after freezing	12,880
Transverse strength, lbs. per sq. in.	3,095
Shearing strength, lbs. per sq. in.	2,478
Loss on corrosion, grams per sq. in.	.01732
Drilling factor, mm.	9.7
Chiselling factor, grams	3.5

The plant consists of:

One electrically operated No. 3 Austin crusher.

" " " No. 3 road machine.

" steam drill and boiler.

Rough stone for building is valued at 50 cents per ton in the quarry.

De Lorimier Quarry Co., J. A. Belanger, president; H. Lalonde, manager, 1962 Iberville Avenue, Montreal.

The property is situated west of Iberville avenue and extends 547 feet south from Dandurand street: it lies opposite the northern opening of Rogers and Quirk.

The quarry is about 300 feet long and 150 feet wide. At the southern end it is quite shallow; but on a practically level floor, it increases in depth to 38 feet at the northern end. This is due to a rise in the country northward, but this depth will not further increase as the summit of the ridge has been reached. At this point are four or five feet of stripping and below are grey "bastard" beds quite the same as those across the road. The nature of the bedding and the character of the joints are also similar.

The plant consists of:

One steam drill and boiler, Canadian Rand.

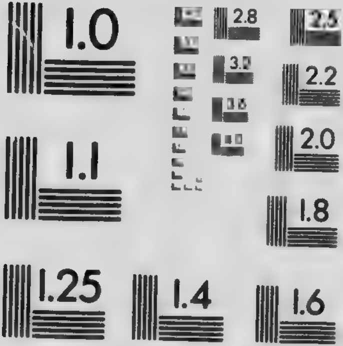
One Acme crusher electrically operated.

Formerly much rough building stone was obtained from this quarry, but the production fell to 15,000 tons in 1910 as the output is nearly all crushed.

Foundation stone is valued at 60 cents per ton in the quarry.

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



APPLIED IMAGE Inc

1653 East Main Street
Rochester, New York 14609
(716) 482 - 0300 - Phone
(716) 288 - 5989 - Fax

Crushed stone is quoted at 90 cents a ton at the quarry. About 200 tons a day are produced and 15 men are employed.

NICOLET GROUP.

A fifth quarry region in the Trenton limestone is situated in the vicinity of Nicolet and Forsythe streets at the eastern limit of the city. Some small quarries have been opened, chiefly in the "banc rouge," near Girard street and Avenue Pie IX, but the only important producer is the firm below

Wm. Joseph Pourpore, 124 Board of Trade Building, Montreal.

The quarry property consists of the block bounded by Forsythe, Hochelaga and Nicolet streets and the line between the city and the town of Maisonneuve. The excavation is 400 feet by 350 feet. The upper stone consists of "banc rouge" to a depth of 6 feet, but this has not been worked since 1905. Beneath the "banc rouge" the excavation has been extended to a depth of 22 feet in thin bedded black limestone. The banc rouge has been removed over a much greater area than that of the present quarry in the limestone. The strike of the limestone beds is due northeast and the dip 7° to the southeast. The joints are well marked but vary greatly in direction, the most distinct series running W. 20°N.

The stone: The product of this quarry consists largely of the black type of thin-bedded limestone, but some of the grey "bastard" variety also occurs.

The plant consists of: -

One No. 5 Gates crusher,

One engine and boiler, 75 h.p.,

One derrick.

The stone is quarried by hand work, about 25 men in all being employed.

The output in 1910 was 30,000 tons, of which about half was sold for rough foundation work at 60 cents per ton in the quarry. At the present time a much larger proportion of the output is sent to the crusher.

MAISONNEUVE GROUP.

Joseph Rhéaume, Maisonneuve P.O. Box 45, Montreal.

The property is situated in Côte la Visitation to the north of the city of Montreal, where the Trenton limestones and banc rouge are thinly covered. It consists of 30 or 40 acres of land bounded by Rosemount boulevard and Beaubien streets and by Kingsboro and Bennett avenues. The quarry is about 600 feet long in a northwest direction by about 400 feet northeast. It is opened to an average depth of 25 feet. The upper stone is banc rouge, which does not occur in a continuous layer, as it is 20 feet thick at the western side, fades to nothing at the north, and appears as a one foot layer intercalated at a depth of 4 feet in the limestones towards the southeast. The underlying limestone beds strike N. 35 E. with a slight dip to the southward. The jointing is variable. The bedding is thin, but 10 and 12 inch stone is obtainable, not however without pronounced banding (586). Both grey and black bands occur, of which the former is preferable for road work as it is much more durable and less brittle than the black stone.

The stone: No. 586. This example resembles No. 583 from Rogers and Quirk's quarry on Iberville avenue, Montreal. The present specimen is very fossiliferous and contains more of the grey crystalline bands and less of the black layers than in the average stone from Rogers and Quirk. The banding is so wavy and contorted that the material has a rough and irregular fracture.

This quarry is worked essentially for crushed stone, and as it is provided with an extensive plant installed at a cost of $100,000, a brief summary of the apparatus is appended.

One No. 7½ Austin crusher operated by
One 125 h.p. motor, Allis-Chalmers-Bullock.
One No. 5 Austin crusher operated by
One 50 h.p. motor,
One No. 3 Champion crusher operated by
One 25 h.p. motor,
One compressor (delivering 427 cubic feet per minute at 100 lbs. pressure), Canadian Automatic Tool Co.
One 100 h.p. motor for compressor,
One 50 h.p. motor for
One hoist to raise cars to feed floor, 8 tons capacity,
One 35 h.p. motor for
One centrifugal pump of 2,000 gallons per minute capacity,
One 8 h.p. motor for machine shop,
One ¼ h p. motor for blacksmith shop,
18 self dumping cars. Five rock drills, two plug drills.

The electrical power enters a small transformer building where its potential is reduced by three Allis-Chalmers-Bullock transformers. This building is provided with a switchboard and a Bristol recorder.

Tracks are laid in a radiating manner from the crushing plant to the working faces. The cars are lifted by electric hoist and discharge automatically between the two larger crushers. A siding connects the property with the Great Northern Railway and also with the city's electric lines.

The quarrying operations are at present being directed to the extension of the opening in the thicker layers of banc rouge to the south and west. The practice is to bore 18 feet holes, 6 feet apart and about 9 feet from the face. They are loaded with 50 per cent and 60 per cent dynamite and are fired simultaneously. The limestone is also being removed by working back in the floor left exposed by the removal of the banc rouge. At present the limestone presents a face of about 7 feet only, but a bore hole of 400 feet showed almost continuous limestone to that depth.

The output may be summarized as below:

Crushed stone, 600 to 700 tons per day for 8 months in the year. Rubble, 64,000 tons in the winter and 500 tons in the summer.

During the summer 70 men are employed, and in the winter, including teamsters, 120 men.

Rubble is valued at 60 cents per ton in the quarry or at $1 per ton delivered in Montreal. Crushed stone is quoted at $1.25 per ton, f.o.b. quarry siding.

CÔTE ST. MICHEL DISTRICT.

The quarries of this district are situated near the road between Côte St. Michel and Côte St. Michel South at a point about a mile and a half east from St. Denis street. North of the road, on the farm of L. Limoges, is one quarry, and on the adjoining farm to the east, that of M. Lapierre, are four operators - M. Lapierre, F. Corbeil, C. Boucher, Jules Petitjean. South of the road is the quarry of O. Lapierre.

O. Lapierre, corner Shaw and Carrière Streets, Montreal.

The opening is about 150 feet square and shows the following succession of beds at the north or deeper end:

0 2 feet	Soil.
1 ft.	All these beds have a strong tendency to split into thinner layers and all have a pronounced banded structure. The stone is not used for making cut stone.
10 in.	
1 ft.	
18 in.	
4 ft.	
5 ft.	Solid bluish limestone. At the south end of the quarry this bed comes much nearer to the surface, partly on account of a rise in the land, and partly because the formation dips at a low angle to the north. At this point a three foot bed of inferior stone underlies the solid blue limestone.

The main joints run N. 10°E. vertically and occur at intervals of 10 to 20 feet. A second set at right angles to the main joints is of very similar arrangement.

Large blocks are easily obtained, some pieces 13 feet in length, 4 feet wide and 2 feet thick having been quarried.

The stone: The good bed consists of a dark blue extremely fossiliferous limestone of coarse character and with variable grain: most of the stone is coarser than that described below. An unfortunate feature is the occurrence of fine veinlets of white calcite as the stone is liable to part along the veins. The presence of these veinlets frequently prevents the quarrying of blocks as large as the jointing would permit. Very little horizontal parting due to clay banding is observed.

No. 595. This example is a semi-crystalline limestone of rather coarse but uniform grain. It is much lighter in colour than the stone from Corbeil's quarry of the Côte St. Michel group described on page 46. The general appearance of the stone is very like that shown in Plate L, No. 4, but it is said to darken considerably on exposure. The physical properties are doubtless close to those of Nos. 584 and 596.

The only equipment is one steam derrick and one steam drill. M. Lapierre uses most of the output as cut stone in his own contracts. Only two men were at work in the quarry at the time of my visit. The stone has been used in some of the medical buildings at McGill University, Montreal.

The four operators on the farm of M. Labelle are working in what is practically one excavation of a crescentic shape in the side of a slight rise from the general level. The quarries are all small and form together a working face extending for 500 or 600 feet east and west. The quarries have an average width of about 100 feet.

The succession of beds varies somewhat along this line of quarries. An average section, as observed in Corbeil's quarry, is given below:
2 ft.—Stripping.
3 ft.—Thin stone.
4 ft.—Good stone (596).
3 ft.—Good stone.

At the other end of the opening, in Petitjean's quarry, the succession is:
3 ft.—Stripping.
3 ft.—Thin stone.
3 ft.—Thick stone but divided in places. This is the only good bed.
4 ft.-6 ft.—Dark and variable stone.

Brief notes on the different quarries are given below:—

M. Lapierre, Côte St. Michel.

The quarry is situated at the southwest corner of the excavation and is being extended in a southwest direction. One derrick is erected and ten men are employed. The product is all used for ashlar and cut stone. The only equipment is one horse derrick. The output is about 1,000 tons a year. Rough squared blocks are delivered in the city after a haul of four miles, for 45 cents per cubic foot. The stone may be seen in the Hotel de Ville at Maisonneuve.

C. Boucher, Côte St. Michel.

M. Boucher employs two men and produces about 500 tons a year. One derrick is installed.

Jules Petitjean, Côte St. Michel.

The equipment on this property consists of one boiler, supplying steam to one steam drill, one pump and one small compressor; two plug drills and two horse derricks. Eight men are employed. About 1,000 tons a year are produced. The stone from all the beds except the 3 foot bed is used for lime burning. The stone from the 3 foot bed is cut into ashlar.

The following prices are quoted:

Coursing stone,	6 and 7 in.	wide,	30	cents per cu. ft. in city.
" "	8 in.	"	35	" " " " "
" "	1 ft.	"	45	" " " " "
Ashlar,	6 and 8 in.	"	20	" per running foot in city.

Francois Corbeil, Côte St. Michel.

The succession of beds has been given above. The 5 foot bed is the best and is selected for description. This stone is much finer in grain than that of O. Lapierre, but it is more marked by shaly bands. On the other hand it is less cut by the fine white calcite veinlets.

The stone: No. 596.—This limestone is shown in Plate L. No. 10. In both grain and colour it very closely resembles the stone from Martineau's quarry in Montreal described as No. 584 on page 33. On smoothed surfaces both stones show the characteristic bluish colour, with the Côte St. Michel stone a little more widely speckled with fossils. The corroded surface is practically the same as in the Martineau stone, showing whitish fossils in a darker ground. The fossils are nearly all *Bryozoa* with scattered sea lily stems: the stone is essentially a *Bryozoan limestone*. The great similarity of this stone and No. 584 makes a comparison of the physical properties interesting. The following list should be compared with the list on page 34.

Specific gravity	2.707
Weight per cubic foot, lbs.	168.345
Pore space, per cent	0.38
Ratio of absorption, per cent, one hour	0.0703
" " " " " two hours	0.0912
" " " " " slow immersion	0.108
" " " " " in vacuo	0.117
" " " " " under pressure	0.141
Coefficient of saturation, one hour	.498
" " " two hours	.647
" " " slow immersion	.717
" " " in vacuo	.832
Crushing strength, lbs. per sq. in., dry	19,520.
" " " " " " wet	19,540.
" " " " " " wet after freezing	16,780.

Transverse strength, lbs. per sq. in..	2,670
Shearing strength, lbs. per sq. in.	1,845
Loss on corrosion, grams per sq. in.	0.0267
Drilling factor, mm.	8.8
Chiselling factor, grams	8

Analysis by Leverin:

	per cent.	
Insoluble matter	0.50	
Ferric oxide and alumina	0.30	
Calcium oxide	53.75	equivalent to 95.98 per cent carbonate of lime.
Magnesium oxide	0.52	equivalent to 1.08 per cent carbonate of magnesia.

It will be observed that all the physical properties of this specimen and No. 584 are closely in accord, with the exception of the drilling and chiselling factors. Judging from the transverse and shearing strengths it would appear that the Martineau stone is more *brittle*. A brittle stone, therefore, other things being equal, may be expected to give a higher drilling factor and a lower chiselling factor.

L. Limoges, Côte St. Michel.

This quarry is situated a short distance to the west of the group described above. The succession of beds is practically the same. From two to five men are employed. One derrick and one steam drill are used. The production is about 1,000 tons a year.

Montreal Water and Power Co., Laurin and Leitch, contractors.
T. A. Morrison, selling agent, 204 St. James Street, Montreal.

The Trenton limestone at Outremont is so invaded with dykes of eruptive rock that the output of quarries in this district is of little use except for making crushed stone. In consequence, this quarry is not listed among the producers of Trenton and Chazy limestone.

The excavation for the reservoir is to be 1000 feet long and 800 feet wide, with a minimum depth of 40 feet; it is situated in Outremont between Maplewood and Pagmuelo avenues. Laurin and Leitch, the contractors for the Water and Power Company, deliver the stone to the T. Morrison company, which disposes of it for road and concrete work. Quarrying is effected by eight Temple-Ingersoll electric air drills. The crusher plant consists of four Gates No. 6 and one Gates No. 1, which handle about 15,000 tons per month, although the actual capacity is much greater. A very complete plant is installed, in which electricity is largely used for hauling and for operating the various labour saving appliances. An extended description of the plant with photographs of the quarry and of the crusher may be found in the report for 1911 of the Mines Branch of the Department of Colonization, Mines and Fisheries of the Province of Quebec.

The stone: No. 901. The Trenton limestone is cut by numerous dykes of eruptive and the formation is so shattered that the production of building stone would be almost impossible. The only material of any possible value from the present point of view is found in places where the heat of the intrusive masses has converted the limestone into marble. The stone thus altered is a fine grained very dark grey crystalline limestone which would have a value as black marble if it could be obtained in pieces of sufficient size.

LACHINE GROUP.

Alphonse Latour, Summerlea Avenue, Montreal.

This quarry lies towards the west of the city at the end of the Lachine car line from Montreal. A small crushing plant is installed. The quarry is now idle. A small amount of the product has been used for foundations.

CAUGHNAWAGA DISTRICT.

Very extensive quarries in the Chazy limestone have been worked to the westward of the village of Caughnawaga. Although some heavy stone for bridge piers has been produced in the past the present operations are conducted for the production of crushed stone and a minor amount of rubble.

The important operators at present are James Turrot and the Bishop Construction Company. Several other properties have been worked but they are now idle.

Bishop Construction Co., Montreal.

The quarry is large and has been worked irregularly over several acres to a depth of about 10 feet. The beds are variable and inclined, with much thin bedding, but material from 8 to 20 inches thick may be procured. Major joints cross N. 40°E. but they are not continuous or well defined. The stone in the heavier beds is of good quality (613) but the irregular character of the formation and the large amount of thin material would make the exploitation of the stone for building purposes rather questionable.

The stone: No. 613. This example presents a true grey colour like Plate L, No. 8; it is also of about the same grain, being a semi-crystalline, medium to coarse grained stone. It very closely resembles the Côte St. Michel stone described as No. 595 on page 45.

James Turrot, Caughnawaga.

This quarry is about one quarter of a mile southeast of that of the Bishop Construction Co. A small amount is sold as rubble but the greater part of the output is sold to the Bishop Company to be crushed.

Chazy limestones resembling those of Caughnawaga occur at St Geneviève at the western end of Montreal island, also on Ile Bizard. Quarries were formerly operated at both these points — at the latter for the locks of the Carillon canal.

POINTE CLAIRE DISTRICT.

McLeod Construction Company, Atwater Avenue, Pointe St. Claire.

A ridge of limestone standing about 35 feet above the general level of the country reaches for a considerable distance in an east and west direction about a quarter of a mile south of the Grand Trunk Railway station at Pointe Claire. More than fifty years ago this outcrop of rocks was worked extensively for the construction of piers along the line of the Grand Trunk Railway. The piers of the Vaudreuil, the Ste. Anne and the Victoria bridges are largely constructed of the stone from this locality.

The central part of the ridge for a distance of 600 yards has been entirely removed. The old working also extended to the east on the south side of the ridge. Here the beds are well exposed and the clean level floor of the old quarry is favourable for a renewal of operations.

After standing idle for many years, the quarry has been reopened by the present company in order to procure crushed stone for use in the construction of the filtration plant at Pointe St. Charles.

The following succession of beds is fairly uniform throughout the exposure:

7 feet—Dark fine grained, splintery limestone in fairly heavy beds in places; in other parts much thinner. All with a tendency to part into thinner layers (903).

Shaly parting.

6 feet Stone like No. 903 but in thinner beds.

Shaly parting.

5 feet Stone like No. 903 in rather heavier beds. In places the beds are 3 feet thick.

— —Shaly parting.

6 feet—Stone like No. 903 but a little lighter in colour, thin beds, 4–8 inches thick.

10 in. Thin bedded dark shaly limestone.

3 ft. 6 in.—Fine grained, compact, light coloured limestone in three solid beds—Building bed; stone like No. 904.

13 in.—Dark, thin bedded shaly limestone.

6 feet—Fine grained, compact, light coloured limestone in five beds. The two lower beds (2 ft. 4 in.) are the most typical of this light coloured stone (904), while the upper beds are somewhat darker.

The stone from all the upper beds is dark, splintery and rough and the layers are not continuous or well defined. This portion is probably to be ascribed to the Black River formation. The condition described above prevails down to the 3 ft. 6 in. bed, at which point the layers are solid, well defined and continuous to the bottom of the excavation. Exclusive of the 13 inches of shaly material, there are 9 ft. 6 in. of this desirable stone at the bottom of the exposure. These lower beds are ascribed to the Lowville (Birdseye) formation; they are cut by vertical joints striking northeast and by a second set running at right angles. Stone 6 feet square could readily be procured.

The stone: No. 903. This is a hard, dark, fine grained stone closely resembling No. 825 (Plate LI No. 3), but it is much harder than that example and probably would be much more difficult to work. The stone is marked with fine white veinlets of secondary calcite and presents occasional calcite crystals throughout.

No. 904. A smooth, even grained, light greyish-white limestone of a very compact texture; it is so fine in grain that a hand lens can not distinguish the individual constituents. This stone would be described as a lithographic variety were it not for the little veinlets and scattered crystals of calcite which occur throughout. The physical properties are probably very similar to those of the stone from Marmora, Ont., described as No. 278 on page 223 of the first volume of this report.

The present operators are quarrying and crushing about 350 tons a day. No attempt is made to save the stone from the building beds, as the whole face of the quarry is blown down by heavy charges of dynamite. The workings are now being advanced in a southwest direction. Seventy men are employed.

ST. LAURENT DISTRICT.

This district is situated to the north and west of the city of Montreal and extends from the vicinity of the village of St. Laurent to Cartierville on the Back river. It may conveniently be divided into two groups the St. Laurent and the Cartierville.

ST. LAURENT GROUP.

The quarries of this group lie a little to the east of the village on the line of the Jacques Cartier Union branch of the Grand Trunk Railway. Although a large quantity of stone was formerly obtained at this point there is no production at the present time. North of the railway are a series of shallow openings extending for a quarter of a mile, and south of the track lies the larger quarry of Francois Dufresne, which is about 100 feet by 150 feet and is said to be 65 feet deep, but is now full of water. While working in the lower levels of this quarry a 6 inch centrifugal pump scarcely sufficed to unwater the excavation. As far as can be seen there is about 10 feet of overburden, with layers of stone not exceeding a foot of thickness to the level of the water. The stone of the lower levels, as judged from a specimen obtained from the old dump, is a semi-crystalline greyish limestone, closely resembling the stone from Cartierville described below as number 598. The beds belong to the Chazy formation.

CARTIERVILLE GROUP.

The quarries of this group lie in the Parish of St. Laurent southwar of Cartierville on both sides of the highway and to the west of the electric railway. Between the railway line and the highway about 15 acres of stone has been removed and there is now left about 3 acres known to be of good material. At the present time four operators are engaged on this property: Jos. Legacé, Paul Chartrand, G. Clermont and E. Bergeron. East of the highway about 15 acres have been quarried and about 3 acres remain of good stone suitable for dressing. Here, Joseph Lapointe is engaged in the quarrying and dressing of building stone, and Demers and Laframboise are prosecuting the crushed stone industry.

Joseph Legacé, Cartierville.
Paul Chartrand "
G. Clermont. "
E. Bergeron. "

As stated above these operators are engaged to the east of the highway; each has a single derrick and employs an average of four men.

The stripping varies from 1 to 6 feet, beneath which are comparatively level beds of stone of which the upper 3 or 4 feet are badly broken and the lower 10 feet present beds varying from 10 to 20 inches in thickness.

The upper stone is excessively jointed but the lower beds are more solid. The chief partings run W. 20°N. at distances of 4 to 10 feet. A set at right angles to the major joints is even more widely spaced. In places the jointing is too close but in other parts fair sized stone is obtainable.

Throughout the lower layers the stone is very uniform in character, of dark colour, rather coarse in grain and highly fossiliferous. Some lamination is seen and the stone parts readily parallel to the bedding.

The stone: No. 598. This example is typical of the present quarry and also of those on the other side of the road; it is a fairly coarse grained, semi-crystalline limestone with a true grey colour without the tinge of brown presented by many of these stones. (Plate L, No. 10). The smoothed surface is bluish and shows crystalline calcite of secondary origin and thin wavy dark lines. The corrosion test shows the usual alteration to a whitish grey colour but the change is less pronounced than in the Montreal stones. The corrosion test also shows that the structure of the stone is very different, as the fossil fragments consist almost entirely of the remains of *Brachiopods.* It is to be expected that the physical properties will differ somewhat on account of this difference of structure. The etched surface presents a coarser speckled appearance on the same account, and the general aspect is less altered, suggesting a harder type of stone.

The physical properties are as follows:

Specific gravity	2.721
Weight per cubic foot, lbs.	169.138
Pore space, per cent	0.4623
Ratio of absorption, per cent, one hour	0.1024
" " " two hours	0.1244
" " " slow immersion	0.1708
" " " in vacuo	0.1726
" " " under pressure	0.1762
Coefficient of saturation, one hour	.582
" " " two hours	.707
" " " slow immersion	.970
" " " under pressure	.08
Crushing strength, lbs. per sq. in., dry	20,500
" " " " wet	18,800
" " " " wet after freezing	18,060
Transverse strength, lbs. per sq. in.	2,830
Shearing strength, lbs. per sq. in.	2,145
Loss on corrosion, grams per sq. in.	0.02226
Drilling factor, mm.	9.5

Chiselling factor. Not determined as the slab split on the bedding under the impact of the chisel.

Analysis by Leverin:

	per cent.	
Insoluble matter	3.56	
Ferric oxide and alumina	1.78	
Calcium oxide	49.90	equivalent to 89.10 per cent carbonate of lime.
Magnesium oxide	1.26	equivalent to 2.63 per cent carbonate of magnesia.

Joseph Lapointe, Cartierville.

M. Lapointe is working at the southeast angle of the old opening west of the road and is extending that opening towards the south. The present face is 15 feet in height and shows beds varying from 6 inches to 2 feet of a stone similar to No. 598 described above. M. Lapointe has one derrick and employs five men in making building and curb stone for Montreal.

The following prices are quoted:

Rough squared blocks, 35 cents to 50 cents per cubic foot at quarry.
Basement tops, point face, bevelled, $1 per cubic foot at quarry.
Coursing stone, one foot, dressed, 50 cents to $1 per foot at quarry.
Standard curbs, 6 by 20 in., 42 cents per running foot in Montreal. (Haulage, 15 cents per foot).

Stone from this quarry has been used for making the [illegible] bed of the Montreal Power Company and the engine bed [illegible] railway at St. Laurent. The stone may be seen in the [illegible] Laurent and at the southwest corner of St. Laurent and St. Catherine streets in Montreal. Stone from this locality was used in the construction of both the old and the new Victoria bridges at Montreal

Demers and Laframboise, Cartierville, operators: H. Co[illegible], Cartie[illegible].

This firm is engaged entirely in the crushed stone industry for the corporation of Cartierville. The original quarry is being extended to the south and west. The plant consists of one jaw crusher (150 ton [illegible] machine, Frankfort, N.J.), one engine and boiler, and one steam d[illegible]. Twenty-five men are employed.

BORDEAUX DISTRICT.

In the bed of the river at Bordeaux the limestones of the Chazy formation are exposed but the country lying inland is well covered by soil for nearly a mile. At this point, however, the rock comes nearer to the surface and several small quarries have been worked to the west of the line of the Canadian Pacific Railway. To the east of the track, Perraud and Audy have a small quarry, but the only one in actual operation is that on the property of the Montreal prison.

Perraud and Audy, 456 Rachel St., Montreal

The opening is 100 feet by 50 feet with a depth [illegible] 5 feet. The beds are about 3 feet thick as far as distinct bedding is concerned, but the stone comes out in much thinner layers owing to a strong development of minor undulating parting planes. Cross bedding is strongly developed in some of the layers. Very well marked joints cross the formation vertically at S. 25° E. There is also a less clearly marked set at right angles and a series crossing diagonally at E. 20° S. A siding connects the property with the railway but no work is being done at present.

The stone: The material from this quarry is strongly laminated with a tendency to split on the bedding and to weather very unequally.

Montreal (Bordeaux) Prison.

On the prison property closely adjoining the quarry described above is an opening 100 feet by 150 feet and 15 feet deep, in which the stone is thin bedded and apparently adapted to rough purposes only. A small crusher is erected here but operations have been suspended.

A larger quarry is situated about half a mile to the south of the above, from which stone is being prepared for the new jail. The opening is 200 feet by 100 feet and is about 9 feet deep at the western end. The succession here is as follows:

3 ft. Stripping.
10 in. Friable bed.
5 ft. Solid stone in places but in others parts into thinner material.
3 ft. Solid bed as above.

The beds dip north at a low angle and are cut by a main series of joints which strike east and west. The partings are well marked and clean at distances of 5 to 10 feet. The other joints are imperfect and variable. The stone, which is very similar throughout, is marked by pronounced wavy bedding planes and is very liable to split parallel to this bedding. It is difficult to find pieces more than 3 inches thick free from this defect, the specimen described below is above the average.

The stone: No. 606.—A medium grained, semi-crystalline limestone of greyish colour (Plate L, No. 11). Smoothed surfaces are bluish, but when wet the colour is quite different from that of the Montreal stone described as No. 584. The whitish fossil fragments are more numerous and closer set in this example and the cementing matter is rather brownish compared with the Montreal stone. The corroded specimen shows numerous calcite crystals which appear dark in contrast to the whitened fossils. The structure is very different from that of the Bryozoan limestones represented by Nos. 584 and 596, and it also differs from the Brachiopod limestone from Cartierville, No. 598. While this latter stone shows long whitish lines where the shells have been cut across, the Bordeaux stone seems to be made up of more fragmentary material. The present stone should be more susceptible to fine chiselling than the Cartierville stone because there would not be as great a tendency for chips to break out along the included shells.

The physical properties are:

Specific gravity	2.727
Weight per cubic foot, lbs.	168.31
Pore space, per cent	1.136
Ratio of absorption, per cent, one hour	0.0963
" " " " " two hours	0.1255
" " " " " slow immersion	0.398
" " " " " in vacuo	0.417
" " " " " under pressure	0.423
Coefficient of saturation, one hour	.227
" " " two hours	.297
" " " slow immersion	.942
" " " in vacuo	.986

Crushing strength, lbs. per sq. in., dry	19,550
" " " " " " wet	18,610
" " " " " " wet after freezing	17,440
Transverse strength, lbs. per sq. in.	2,792
Shearing strength, lbs. per sq. in.	1,445
Loss on corrosion, grams per sq. in.	0.02374
Drilling factor, mm.	9.8
Chiselling factor, grams	4.4

Analysis by Leverin:

	per cent.
Insoluble matter	2.76
Ferric oxide and alumina	1.20
Calcium oxide	50.60 equivalent to 90.35 per cent carbonate of lime.
Magnesium oxide	1.76 equivalent to 3.67 per cent carbonate of magnesia.

The equipment consists of three hand derricks, one steam drill, one compressor, two plug drills, and one Anderson diamond saw operated by electric power. A siding connects the property with the Canadian Pacific Railway. Three quarrymen, five stonecutters and three mill hands are employed. Nearly the whole output has been used in the construction of the prison.

St. Martin District.

The quarries of Chazy limestone in the parish of St. Martin fall naturally into three groups—the Cap St. Martin, the Village Belanger and the Village St. Martin.

CAP ST. MARTIN GROUP.

Immediately to the east of Quebec Junction and extending for about a mile in that direction is a slightly elevated tract of country, falling off rather abruptly to the north and with a less pronounced descent to the south. The Quebec line of the Canadian Pacific Railway passes a short distance north of the slight escarpment, along which are situated the quarries of the Cap St. Martin group.

L. Paquette, Cap St. Martin, Que.

This is the northwesterly property now being worked, although small openings have been made still nearer to Quebec Junction. The property consists of 21 acres, being 540 feet wide and 1260 feet long. The quarry is advancing to the south in the one-fourth which has not already been worked.

The succession of beds is as below:

6 ft.—Soil.
2 ft.—Solid bed }
2 ft.—Solid bed } Good building stone (602).
2 ft.—Solid bed }
6 ft.—Solid bed but harder and more adapted to heavy construction not now being quarried.

The good beds are solid and fairly uniform, but some banding is apparent in places. On the whole, however, the stone is more homogeneous in character than in most of the quarries of the Trenton formation. Absolutely no difference is perceptible in the colour or grain of the stone from the three good beds, which are now alone quarried as no contracts for bridge stone are on hand. The major joints, which are well defined, cut the formation vertically in a direction 15° south of east and at convenient intervals for quarrying large blocks. The set at right angles to the above is more irregular and the joints are wider spaced.

The stone: No. 602—This example is of coarse grain and light greyish colour, resembling Nos. 706 and 709 from the Chazy quarries at Grande Ligne (Plate L, Nos. 4 and 8, pages 73 and 75). It is somewhat coarser in grain and lighter in colour than the stone from the other side of the ridge at village Belanger (No. 605) but it is probably very similar in its physical properties.

An analysis by Leverin gave:

	per cent	
Insoluble matter	2.76	
Ferric oxide and alumina	1.20	
Calcium oxide	52.05	equivalent to 92.94 per cent carbonate of lime.
Magnesium oxide	0.84	equivalent to 1.75 per cent carbonate of magnesia.

The only equipment consists of two derricks, one operated by hand and the other by horse power. Twenty-one men are employed, some of whom are quarrymen and the rest stonecutters. All the product is used for building, about 600 cubic feet a month being shipped during ten months in the year. The prices quoted are as follows:

Rough squared blocks, 30 cents per cubic foot, f.o.b. quarry.
Cut stone, bedded, two faces bushed, $1 per cubic foot, f.o.b. quarry.

Isaie Desormeaux, Cap St. Martin, Que.

M. Desormeaux holds the block of land lying to the east of Paquette's and extending to the Montreal-St. Lawrence main road. Here a large quarry was formerly worked, but M. Desormeaux is holding this property in reserve at present, as well as a block to the east of the above road. Both these properties lie to the north of Grand Prairies road, but M. Desormeaux is now working on a third irregularly shaped piece of land still farther east and to the south of the Grand Prairies road. The quarry here is about 100 feet square and is opened to a depth of 10 feet. The succession is as follows:

0 2 ft. —Soil.
6 ft. Solid bed.
1 ft. 6 in. " "
2 ft. " " (603).
3 ft. "

This quarry was opened in May of this year and all the output has been used for fine cut work to which it is particularly adapted.

The Stone: No. 603.—This example is of considerably finer grain than No. 602 from Paquette's quarry; it is light in colour like No. 602, but shows a slight tinge of brown not seen in the true grey of No. 602. The stone from Brunet's quarry at St. Vincent de Paul (No. 591) is very similar to the present example; it is said that the two stones are frequently used together in the same building.

The equipment consists of four horse derricks, one boiler, one small compressor, one air drill, and two plug drills. Twenty men are employed, 12 of these being quarrymen. A siding connects the property with the Canadian Pacific Railway.

M. Desormeaux quotes the following prices:

Rough squared blocks, $7-8 per yard, f.o.b. siding.

Corner stone, 1 ft. high, 1 ft. wide, bushed on two faces, 70 cents per cubic foot, f.o.b. siding.

Sills, 2 brick, bushed top and face, 65 cents per running foot, f.o.b. siding.

Sills, 2 brick, bushed top and face, fine chiselled, 75 cents per running foot, f.o.b. siding.

Coursing stone, 1 ft. high, fine bushed, 65 cents per running foot, f.o.b. siding.

This stone may be seen in some of the McGill University buildings and in the large structure near the corner of Laurier avenue and St. Laurent street, Montreal.

Fevetule Saumur, Cap St. Martin, Que.

M. Samur operates a small quarry on the Desormeaux property.

Joseph Dagenais, St. Elzear de Laval, Que.

M. Dagenais owns the land between the railway and Desormeaux's middle property and a large block to the east of that property extending from the railway across the Grand Prairies road and surrounding the irregular section on which M. Desormeaux is now working. On this estate the following operators are working under lease: -

St. Laurent Quarry Co.,
Hormidas Despres (also partly on the Desormeaux property),
A. Monette,
Xavier Paquette,
Legrenier,

St. Laurent Quarry Co., Francois Dufresne.

This quarry is being opened at a low level in the face of the bluff and is advancing in beds at a much lower level than those already described. The formation dips slightly into the hill, i.e. south, and the whole face of 30 feet shows beds of greyish crystalline limestone in layers varying from 6 to 18 inches in thickness.

The main joints strike N. 15°W. and dip vertically. A second set striking W. 20°S. dips 60° to the northward.

The stone: Most of the stone shows distinct wavy banding in dark lines and it is not comparable with the upper beds as a building material, although some good stone was cut from the quarry. At the present time, certain of the beds are equal to the stone from higher levels but the general run of the output is much harder and more banded.

The plant consists of one Austin No. 5 crusher, operated by a 45 h.p. engine and boiler, one Austin No. 3 crusher operated by an 18 h.p. engine and boiler, two steam derricks, and one steam drill. The total output is crushed and loaded directly into cars on a siding from the Canadian Pacific Railway.

Hormidas Despres, Cap St. Martin, Que.

The quarry is small and extends from the Dagenais estate to the property of Desormeaux. It is opened to the same depth in the same stone that has already been described for Desormeaux's quarry. The plant consists of two hand derricks. Fifteen men are employed. The total output is made into fine cut stone.

Adelarde Monette, Cap St. Martin, Que.

This quarry is continuous with that of Despres. Two derricks are installed. Fifteen men are employed. The total output is made into fine cut stone.

Xavier Paquette, Cap St. Martin, Que.

A small quarry to the northwest of the above on the Dagenais estate.

— Legrenier, Cap St. Martin, Que.

A small quarry on the Dagenais estate to the west of the St. Laurent Quarry Co.

VILLAGE BELANGER GROUP.

The quarries of this group are situated on the south side of the ridge, which furnishes the Cap St. Martin stone. The distance is less than a mile between the two groups of quarries. The present group extends eastward from the property of L. Gauthier on the St. Lawrence main road. Owing to the southward dip of the strata it is likely that these beds are higher in the formation than the Cap St. Martin beds. The stone is similar, but shows some bandings and on the whole is scarcely as fine a stone as that of Cap St. Martin.

The ridge slopes up very gently here, and there is an average stripping of 2 feet. All the quarries are small and they all show a slight difference in the succession of beds. A general idea of the beds however, may be obtained from the following typical section:

3 ft.—Soil.
3 ft.—Thin stone.
3 ft.—Solid bed.
1 ft.— “
8 in. “
3-4 ft “

The stone: No. 605.—The product of these quarries is very similar throughout and differs from the Cap St. Martin stone by possessing a more distinct banding and a darker colour. The colour and grain are shown in Plate L, No. 6. The fractured surface shows the usual broken crystals presented by these semi-crystalline, fossiliferous limestones, but it also shows a characteristic surface of little rounded points which probably represent the casts of *Ostracod* shells. This same peculiarity is shown to a less degree by the stone from Cap St. Martin but it is not presented by any other of the limestones examined.

The corroded surface shows the same greyish white appearance as the other limestones of the Montreal area, but the characteristic structure is revealed in rounded dots of calcite bordered with a fine white line, which makes it easy to distinguish this stone from any other limestone of the Montreal area.

The physical properties are as follows:—

Specific gravity	2.713
Weight per cubic foot, lbs.	168.72
Pore space, per cent	0.378
Ratio of absorption, per cent, one hour	0.098
“ “ “ “ “ two hours	0.1016
“ “ “ “ “ slow immersion	0.1297
“ “ “ “ “ in vacuo	0.1402
“ “ “ “ “ under pressure	0.1402

Coefficient of saturation, one hour	.698
" " " two hours	.726
" " " slow immersion	.927
" " " under pressure	1.00
Crushing strength, lbs. per sq. in., dry	24,450.
" " " " " " wet	22,780
" " " " " " wet after freezing	19,940.
Transverse strength, lbs. per sq. in.	2,948.
Shearing strength, lbs. per sq. in.	1,225.
Loss on corrosion, grams per sq. in.	0.0298
Drilling factor, mm.	9.5
Chiselling factor, grams	7.2

The individual operators now at work in this section are each provided with one derrick and are directing their efforts to the production of fine cut stone. In all about 40 men are employed and three to four loads a day are shipped during the summer. The more important operators are:

Gregoire Dagenais, Village Belanger.
Roche Delcourt, " "
S. Laurin, " "
Prosper Laviolette, " "

VILLAGE ST. MARTIN GROUP.

The quarries of this group are situated about a mile east of the village and south of the main road. The quarry lands consist of three lots, from the west to the east as follows:

D. Bigras—40 acres.
Alma Gauthier,—38 acres.
Elie Bigras,—18 acres.

Towards the north end of these lots the soil is thin or absent but where most of the work is now being done there is a stripping of about 4 feet. The stone is solid to the surface and shows well marked glacial striæ. For the most part, only two beds of 3 feet each are worked. These beds are quite solid in places but in others divide easily into two layers each. The joints are well marked at E. 30° S. and at right angles to that direction. In both sets the partings are 10 to 20 feet apart. Some irregular cracks are seen but large stone is easily obtainable.

On the whole the stone shows an excess of lamination and might be expected to weather unevenly. Some veinlets of white calcite also detract from its value. The facility with which the beds split parallel to the bedding aids the making of curb stone for which purpose the whole output is at present u

The stone: No. 604. This stone is shown in Plate L., No. 15; it is very much darker, more laminated and of much finer grain than the varieties from Cap St. Martin or Village Belanger. The smoothed surface has the usual bluish appearance and is very finely dotted with white fossil fragments. The corroded surface presents a "pepper and salt" effect and shows that the fossil fragments had been much broken before the stone hardened:

The physical properties follow:

Specific gravity	2.722
Weight per cubic foot, lbs.	169.2
Pore space, per cent.	0.434
Ratio of absorption, per cent, one hour	0.095
" " " " " two hours	0.119
" " " " " slow immersion	0.156
" " " " " in vacuo	0.1603
" " " " " under pressure	0.1603
Coefficient of saturation, one hour	.593
" " " two hours	.743
" " " slow immersion	.973
" " " in vacuo	1.00
Crushing strength, lbs. per sq. in., dry	22,350.
" " " " " wet	21,400.
" " " " " wet after freezing	20,220.
Transverse strength, lbs. per sq. in.	3,083.
Shearing strength, lbs. per sq. in.	2,155.
Loss on corrosion, grams per sq. in.	0.01718
Drilling factor, mm.	10.7
Chiselling factor, grams	6.

Analysis by Leverin:—

	per cent.	
Insoluble matter	6.04	
Ferric oxide and alumina	1.30	
Calcium oxide	51.20	equivalent to 91.42 per cent carbonate of lime.
Magnesium oxide	1.26	equivalent to 2.63 per cent carbonate of magnesia.

On the three farms a large number of operators are at work. The total equipment is 15 hand derricks. About 60 men are employed and 100,000 feet of standard Montreal curbing (6 × 20) are made in a year. This output is valued at 40 cents per running foot delivered in the city.

The present lessees are as follows:

Farm	Lessee	P.O. Address
Damien Bigras	Olivas Valiquette	Bord à Plouffe
"	Leandre Valade	St. Martin
"	Olidon Legacé	Bord à Plouffe
"	Joseph J[illegible]tte	Cartierville
Alma Gauthier	Henri Cousineau	St Martin
"	Wm. Paquette	"
"	Romain Clermont	Bord à Plouffe
"	Albert Clermont	" "
"	Isaie Legacé	Bordeaux
"	Honoré Clermont	Parc Laval
"	Delphis Ouellette	Cartierville
"	Joseph Jany	Bordeaux
"	Isidore Valiquet	Bord à Plouffe
"	Joseph Paquette	St. Martin
Elie Bigras	Alphonse Legacé	Cartierville.

St. Vincent de Paul District.

The quarries in the Trenton limestones in the parish of St. Vincent de Paul are situated three miles west of the village, one being located close to the river at this point and the others about a mile and a half northward near the line of the Canadian Pacific Railway. The northern and more important group is now in the hands of two operators only—The Standard Quarry Co. and Napoleon Brunet; the southern quarry is operated by Ulric Sauriol.

Standard Quarry Co. Limited, Montreal, G. H. Morin, manager, 30 St. John Street, Montreal. Formerly Leger et Cie.

The property consists of thirty acres, situated south of the Canadian Pacific Railway about three miles west of St. Vincent de Paul station. Several small openings have been made by individual operators in the past. The present quarry presents an irregular working face of about 200 feet in length which is being exploited towards the southeast. The beds are somewhat variable but the general succession is indicated below:

0 3 ft. -Soil.

10 ft. -Beds 6 to 18 inches thick.

10 ft.—Heavy beds 2, 3 and 4 ft. in thickness.

The upper 10 feet is less desirable stone and although some of it is thick enough to cut, the present practice is to send it all to the crusher.

The lower 10 feet is used entirely for the production of building stone (No. 590).

The main joints run N. 20°W. and are often as much as 20 feet apart. A second, less defined series runs N. 25°E. Both sets are vertical and both vary from the directions given above. Very large stones are easily obtained, blocks of eight tons in weight being frequently raised.

The stone: No. 590. The stone in these quarries varies considerably in grain, with argillaceous layers disposed irregularly in the beds. An average sample is shown in Plate L, No. 13, in which a medium to fine grain is presented. The smoothed surface is bluish when dry, but after wetting it has a brownish cast with numerous white dots. The corroded example shows a general greyish white stone with a "pepper and salt" effect. Large fossil fragments are not observed but occasional wavy dark lines representing bituminous partings are seen. Examination with a lens shows scattered oolitic concretions resembling those of the stone from St. Francois de Salles (page 67) but in considerably less amount.

The physical properties are as follows:

Specific gravity	2.709
Weight per cubic foot, lbs	168.15
Pore space, per cent	0.568
Ratio of absorption, per cent, one hour	0.092
" " " two hours	0.1093
" " " slow immersion	0.208
" " " in vacuo	0.208
" " " under pressure	0.211
Coefficient of saturation, one hour	.435
" " " two hours	.518
" " " slow immersion	.985
" " " in vacuo	.985
Crushing strength, lbs. per sq. in., dry	22,350.
" " " " wet	21,200.
" " " " wet after freezing	20,650.
Transverse strength, lbs. per sq. in	3,495.
Shearing strength, lbs. per sq. in	1,940.
Loss on corrosion, grams per sq. in.	0.0183
Drilling factor, mm	9.
Chiselling factor, grams	8.2

Analysis by Leverin:

	per cent.	
Insoluble matter	0.60	
Ferric oxide and alumina	0.52	
Calcium oxide	53.35	equivalent to 95.27 per cent carbonate of lime.
Magnesium oxide	0.64	equivalent to 1.33 per cent carbonate of magnesia

An analysis of stone from these quarries but evidently of material less carefully selected was made by Dr. Milton L. Hersey. The company has kindly communicated the results as follows:

	per cent
Siliceous matter..	2.59
Oxide of iron	1.25
Alumina.	.73
Lime.	47.45
Magnesia.	4.36
Sulphuric anhydride.	.51
Loss on ignition...	42.60

Probably combined as follows.

Calcium carbonate..........	84.73
Magnesium carbonate..	9.16
Calcium sulphate....	.87
Silica..........	2.59
Oxide of iron...	1.25
Alumina....	.73
Organic matter.....	.52
Undetermined...	.15

The following equipment has been installed:

Siding from C.P.R.
One horse derrick,
One Gates crusher, 300 tons a day capacity, electric power,
One jaw crusher, 130 tons a day capacity, steam power,
One compressor,
One rock drill,
Four plug drills.

Forty men are employed in the quarry and in connexion with the crushers, and 10 stonecutters. It is expected that 600 cars of crushed stone and 200 cars of rough stone will be shipped in 1911.

Rough squared blocks are valued at $6 per cu. yard, f.o.b.

Ashlar varies from 25 cents to 60 cents per running foot.

The stone has been largely used in Montreal and may be seen in the post-office building in that city.

Napoleon Brunet, St. Vincent de Paul, Que.

This property consists of 12 acres situated immediately to the west of that described above. The quarries are practically continuous. In the present case, the working face is about 100 feet long and, as in the other quarry, it is advancing towards the southeast. The thicknesses of the individual beds do not exactly correspond with those in the other quarry but the general succession is the same.

The stone: No. 591. -This example is of slightly coarser grain and considerably lighter colour than No. 590; it most closely resembles the stone from Bordeaux (No. 606) but it is of somewhat finer grain. It contains comparatively few but pronounced shaly partings. In both grain and colour the stone is almost identical with No. 603 from Cap St. Martin.

The equipment consists of two horse derricks, one Canadian Rand compressor, one gasoline engine, and one rock drill which is also used for plug work.

Eight to ten men are employed and all the product is used for building. About 1500 cubic feet a month are shipped. A good example of this stone may be seen in the residence of M. Napoleon Leonard, corner Laurier avenue and St. Hubert street, Montreal

Ulric Sauriol, St. Vincent de Paul, Que.

M. Sauriol has opened a small quarry in the face of the bluff overlooking the river about 3 miles west of St. Vincent de Paul. The bluff is about 100 feet high. The upper 50 feet consist of poor, thin material: this is followed by 12 feet of good stone with thin material below to the level of the water. The workable beds show the following succession in descending order:

15 in. -Part thin, but in places good.
6-8 in. Good bed.
10 in. " "
18 in. " "
14 in. " "
19 in. " "
2 ft. " "

These beds show throughout less lamination and clayey bands than was seen in the more northerly quarries of the group. It is regrettable that the heavy overburden will soon make the work of extraction much more difficult.

The stone: No. 592. This example is homogeneous and without laminations. It is easily worked, does not chip out and probably represents the finest type of stone from the district. In both grain and colour it closely resembles No. 596 (Plate L, No. 10) from Corbeil's quarry at Côte St. Michel. In places there are small masses of fine grained material containing crystals of zinc blende, but these are not sufficiently numerous to detract greatly from the value of the stone.

An analysis by Leverin gave:

	per cent.
Insoluble matter............	1.00
Ferric oxide and alumina....	0.86
Calcium oxide..............	52.15 equivalent to 93.17 per cent carbonate of lime.
Magnesium oxide...........	0.60 equivalent to 1.25 per cent carbonate of magnesia.

M. Sauriol employs three men and ships about 60 cubic feet a week during the summer. He has kindly furnished the following prices, all delivered in Montreal

Rough, squared stone, $1 per cubic foot.
Sills, 4 inch, 11½ in. wide, bushed top and face, 40 cents per running foot.
Sills, 6 inch, 11½ in. wide, bushed top and face, 50 cents per running foot.

The buildings of the penitentiary and the churches in St. Vincent de Paul show many irregular streaks and bedding planes on the hammered surfaces. This is more apparent on the older and more weathered buildings where decidedly different colours are shown parallel to the bedding. The stone from Sauriol's quarry seems to be the most uniform in grain and practically without discoloured streaks.

ST. FRANCOIS DE SALLES DISTRICT.

This district lies in the Trenton formation near the boundary between the parishes of St. Francois de Salles and St. Vincent de Paul in the county of Laval; it is intersected by the Terrebonne road and is connected by a siding with the Canadian Pacific Railway. Enormous quantities of stone have been obtained here, particularly for purposes of heavy construction. Among the many abandoned quarries may be mentioned that of Connelley from which large quantities of heavy stone were obtained for bridge and canal work before the railway was built. At the present time three companies are operating in the district—Louis Labelle and Co., the Terrebonne Quarry Co., and Charbonneau Frères.

Louis Labelle et Cie., 57 Notre Dame St. W., Montreal.

M. Felix Labelle is the owner of lots 92, 93 and 94 in the parish of St. Francois de Salles. The stone on lot 92 has been largely removed and this company as well as the Terrebonne Quarry Co. are carrying on operations on the remaining parts of these three lots.

The quarry presents an irregular working face of about 300 feet in extent. A section 75 feet long is now being advanced in a westerly direction in two benches, the upper being a short distance in advance of the lower. The soil varies from 0-4 feet in thickness and, with the exception of about one foot of thin material, the stone is all in heavy beds to the bottom of the excavation. These beds are not continuous: both in the upper bench and in the lower bench they vary from 1 to 3 feet in thickness, and dip a few degrees to the westward. The main joints run east and west and are usually about 10 feet apart. The second set of joints, at right angles to the above, is irregularly developed with the partings widely spaced. Stone 15 feet long is easily obtained. The beds show considerable lamination and, in places, false bedding is apparent.

The stone: Owing to considerable variation in the character of the stone two examples are described. No. 594 is a selected piece while No. 593 represents the average stone.

No. 594. This example is shown in Plate L., No. 5; it is of a darkish colour with a slightly brownish cast and most closely resembles the Hull stone described as No. 629 and figured in Plate L., No. 7.

The smoothed surface is very uniform and bluish when dry but when wet it has a prevailing brownish cast dotted with white specks. The etched surface is very characteristic as it shows the presence of numerous little spheres about ½ mm. in diameter. This feature is also observed in No. 709 from St. George's quarry near Grand Ligne and to a lesser extent in No. 706 from Otis' quarry in the same locality and in the stone from St. Vincent de Paul.

The physical properties are as follows:

Specific gravity..	2.708
Weight per cubic foot, lbs.	168.253
Pore space, per cent..	0.4704
Ratio of absorption, per cent, one hour	0.107
" " " two hours	0.128
" " " slow immersion	0.1632
" " " in vacuo....	0.1632
" " " under pressure	0.1742
Coefficient of saturation, one hour..	.615
" " " two hours	.737
" " " slow immersion	.936
" " " in vacuo..	.936
Crushing strength, lbs. per sq. in., dry	20,450
" " " " wet.	20,850
" " " " wet after freezing.	19,680
Transverse strength, lbs. per sq. in. ..	3,010
Shearing strength, lbs. per sq. in.	1,470.
Loss on corrosion, grams per sq. in.	0.02425
Drilling factor, mm	7.9
Chiselling factor, grams	5.6

Analysis by Leverin:

	per cent	
Insoluble matter.........	2.26	
Ferric oxide and alumina .	0.56	
Calcium oxide....	53.30	equivalent to 95.18 per cent carbonate of lime.
Magnesium oxide..........	0.74	equivalent to 1.52 per cent carbonate magnesia.

No. 593. This stone resembles No. 594 but it is of somewhat finer grain and contains dark splashes. The bedding is shown by fine, black, wavy argillaceous lines from one quarter to an inch apart. This stone represents the average run of the quarry while No. 594 is a selected sample with a minimum of the dark lines.

This is essentially a heavy stone quarry; the output is particularly adaptable to bridge and canal work but it is employed for architectural purposes as well.

The plant consists of two steam derricks, one horse derrick and one steam drill.

Twenty-four quarrymen, 2 blacksmiths and 16 cutters are employed. The output is about 8,000 tons a year of building or bridge stone.

Roughly squared blocks are valued at $6 per cubic yard, f.o.b. quarries.

Stone is now being cut for the piers of the new Canadian Pacific Railway bridge at Lachine; it may also be seen in the convent on Sherbrooke street, Montreal, and in the building at the corner of Notre Dame and St. Lambert streets.

Terrebonne Quarry Co., St. Francois de Salles, Que.

This company operates on lots 93 and 94 immediately to the east of the Louis Labelle Co. The quarries are continuous. This company is advancing its working face west and south in two benches, the upper of 12 and the lower of 14 feet. The character of the bedding and of the jointing is the same as that already described for the Labelle quarry. Blocks 15 × 15 feet have been obtained here.

The stone: The stone does not differ from that of the adjacent quarry already described. It is found that plug holes, 4 inches apart, suffice for breaking the stone from the 2 ft. 6 in. beds.

The equipment consists of three steam drills, one compressor, one engine and boiler, one Champion crusher operated by steam, one No. 3 Gates crusher, one No. 5 Gates crusher operated by electricity, two steam drills and two plug drills. The quarry is connected by a siding with the Canadian Pacific railway.

Fifty men are employed at present: the output is being made into curbing stone for Quebec (9 in. × 12 in.).

Rough blocks 6 feet or less in length are valued at $6 per cu. yard, f.o.b., and stone over 6 feet long at $8 per cubic yard.

The stone may be seen in the Ville Marie convent, Westmount, the Masson building, Notre Dame and St. Lambert streets, the post-office in Terrebonne, and in the Lachine bridge.

Charbonneau Frères, St. Francois de Salles, Que.

This quarry lies north of the Terrebonne road on the property of M. Joseph Masson. The face is 25 feet high and is advancing towards the south. The bedding and jointing are the same as already described but the north and south joints are closer together and in places cause the loss of considerable stone.

The equipment consists of four derricks, three operated by steam and one by horse power. Twelve men are now working. This stone is quite the same as that from the other two properties: it may be seen in the new part of the Château Frontenac at Quebec.

Gilgas Gauthier, St. Francois de Salles, Que.

This quarry is essentially a part of the Charbonneau quarry and requires no further description. The stone is the same. Twelve men are at present employed.

Other quarries in this group have been worked from time to time by Leroux, Depacie, Charbonneau, and others. The product of some of the earlier quarries may be seen in the church at St. Francois de Salles. The stone is badly etched along the clayey partings which sometimes run diagonally across the block. The prison, built 15 years ago, shows the same defects in a less degree.

Summary—Montreal Area.

The city of Montreal is constructed largely of limestone which is quarried within the city, on Montreal island, or on Ile Jesus within a short distance. The stone is derived from the Chazy and Trenton formations and may be considered as presenting three varieties—a greyish, medium grained, semi-crystalline type, a hard dark fine grained variety, and a stone which practically consists of an interbanding of the first two. The first variety is a high grade stone suitable for dressed work, the second is used for rock-face work only, and the third is applicable to rock-face work of an inferior kind but is chiefly used for rubble and for making crushed stone.

The production of high grade building stone within the city limits is decreasing in amount and stone is now procured from two quarries only—The Villeray Quarry Co. and O. Martineau et Fils. The other districts from which stone for building purposes is now obtained on Montreal island are Bordeaux, Côte St. Michel, and Cartierville. On Ile Jesus the chief districts are St. Martin, St. Vincent de Paul, and St. Francois de Salles.

The best stone from all these localities may be considered as of one general type, although differences of grain and colour may be easily recognized. The most serious defect is the presence of thin clayey bands which are present to a greater or less extent in all the quarries. It may be said that the best stone, irrespective of the quarry from which it is derived, is that in which a minimum of these clayey partings is present. The physical properties of the Montreal stone may be judged from the following list which represents the average of nine selected stones from the different quarries:—

Specific gravity	2.714
Weight per cubic foot, lbs.	168.53
Pore space, per cent	0.519
Ratio of absorption, per cent	0.191
Coefficient of saturation	.917
Crushing strength, lbs. per sq. in., dry	21,460.
" " " " wet	20,456.
" " " " wet after freezing	18,800.
Transverse strength, lbs. per sq. in.	2,853.
Shearing strength, lbs. per sq. in.	1,661.
Loss on corrosion, grams per sq. in	0.0239
Drilling factor, mm.	10.8
Chiselling factor, grams	6.3

None of the nine examples depart very much from these averages which may therefore be considered as fairly well representing the properties of the Montreal stone.

Literature: Geol. Sur. Can., Report 1863, p. 817-818.
Geol. Sur. Can., Report 1894, p. 89 J.
Geol. Sur. Can., Report 1900, p. 140 A.
Geol. Sur. Can., Report 1901, pp. 1-70 O.
Geol. Sur. Can., Report 1894, pp. 45-47 J.
Royal Soc. Can., Sec. IV, pp. 154-164, 1900.
Rep. Mining Operations in the Province of Quebec, 1911, pp. 52-70.
Geol. Sur. Can., Report, 1888-89, p. 122 K.

ST. JOHNS-GRANDE LIGNE AREA.

This area is established for the reception of two groups of quarries in the county of St. Johns: one of these groups lies in Trenton or Black River limestone, west of the city of St. Johns and the other in Chazy stone a few miles to the south, near Grande Ligne.

St. Johns District.

Narcisse Lord, St. Johns, Que.; Lot 231, Parish of St. John;
Lots 151 and 152, Parish of L'Acadie.

The quarry of Trenton limestone in the parish of St. John is the only one that has been worked in recent years; it is situated on a property of 40 acres about 2½ miles west of the city of St. Johns.

The opening is about 300 feet by 150 feet with a maximum depth of 30 feet. The average depth would not exceed 20 feet. The stone is thin bedded throughout and the various layers are separated by shaly partings sometimes of considerable thickness. Most of the limestone is of a very dark blue colour but this type is interbanded with a lighter greyish variety. It is seldom that any part of a bed exceeds 10 inches in thickness. The formation is practically horizontal but there is a slight inclination N. 10° E. At the northern end of the quarry, the beds show evidence of crumpling. The main joints strike N. 10° W. at frequent intervals. White calcite is of common occurrence on these planes as well as in veinlets, with an approximately parallel direction. A second set of joints run N. 40° W. with a vertical dip. The stripping is light and would not average more than 18 inches.

The stone: No. 700.—This example is a hard fine grained dark grey limestone resembling No. 903 from Pointe Claire but with a somewhat lighter true grey, and livelier tone. The rubbed surface is blue, even grained and uniform. The etched surface is grey, minutely speckled with white. The physical properties follow:

Specific gravity	2.713
Weight per cubic foot, lbs.	169.224
Pore space, per cent	0.081
Ratio of absorption, per cent, one hour	0.0074
" " " " " two hours	0.0097
" " " " " slow immersion	0.0229
" " " " " in vacuo	0.0298
" " " " " under pressure	0.0298
Coefficient of saturation, one hour	.25
" " " two hours	.33
" " " slow immersion	.76
" " " in vacuo	1.00
Crushing strength, lbs. per sq. in., dry	31,462.
" " " " " " wet	30,810.
" " " " " " wet after freezing	29,439.
Transverse strength, lbs. per sq. in.	4,550.
Shearing strength, lbs. per sq. in.	2,075.
Loss on corrosion, grams per sq. in.	0.02455
Drilling factor, mm	4.8
Chiselling factor, grams	5.7

An analysis by Leverin gave:

	per cent.	
Insoluble matter	3.14	
Ferric oxide and alumina	.50	
Calcium oxide	52.9	equivalent to 94.46 per cent carbonate of lime.
Magnesium oxide	.82	equivalent to 1.71 per cent carbonate of magnesia.
Combined water	.54	

The stone is too thinly bedded and too much fractured to be of great value as a building material. When used for structural purposes, it is employed for foundations only, e.g. in the National Hotel, Singer Manufacturing Company's building and many other structures in St. Johns. Most of the output is crushed for road metal. A small crushing plant of 80 tons per day capacity is operated on the property. Crushed stone is delivered in St. Johns at $1.50 per ton and foundation stone at $12 per toise.

It is said that about a square mile of similar stone is accessible under a slight stripping in this vicinity.

The quarry lands in L'Acadie have not been worked in many years. The stone is similar to that described above but it occurs in much thicker beds. Many of the buildings in St. Johns, Iberville and other towns have been constructed of stone from this vicinity.

The church in St. Johns was built 46 years ago and shows the effect of the weather in the assumption of a much lighter colour with a yellowish cast. Yellow and black stains are very evident in places. The bedding planes are accentuated by the etching out of the more argillaceous layers. Some of the blocks, however, present a uniform yellowish grey colour of pleasing tone.

The Merchants Bank and the Bank of St. Johns in St. Johns are also constructed of this stone. Both these structures are of more recent date and present a yellowish grey appearance with the stratification planes but slightly defined.

GRAND LIGNE DISTRICT.

The limestones of the Chazy formation are covered by a very thin layer of soil in the region to the north and northwest of Grande Ligne in the county of St. Johns. Stone for building and other purposes has been procured in this area for many years. Formerly the output found its chief application in local buildings but of recent years a large amount of crushed stone has been shipped to Montreal and other points. Although stone has been raised at a number of places the following operators are, or rather have been, the most important:

Alexander St. George, Grande Ligne, Que.
Edouard Poirier, " " "
Louis Perron, " " "
Mr. Otis, Rouses Point, Vt.

Alexander St. George, Grande Ligne, Que.; Lot 14, Parish of St. Blaise, St. Johns county.

The quarry is about 100 feet long by 40 feet wide and has been opened to a depth of 8 feet. The beds dip north at a low angle and are cut by a major series of vertical joints striking northwest. These joints are as much as 10 feet apart: they do not appear to be crossed by a second defined set although irregular fractures occur. Large blocks can be obtained with facility. Three beds have been worked as below:—

Upper bed, 22 inches thick, crystalline in character and variable in grain and colour. At the western end the stone is grey but towards the east it is speckled with red (708, 708 b).

Second bed, 18 inches thick, uniform, grey crystalline; probably the best stone (709).

Third bed, 11 inches thick, blue and less crystalline; a less desirable stone (710).

The stone: As observed in Grande Ligne, the stone from this quarry, particularly the grey type, retains its colour with very little change. Hammered work is distinctly lighter than the rock-face and is quite uniform and unstained after many years' exposure. In certain blocks of the rock-face masonry a distinct yellow discolouration is observable together with an intensification of the planes of stratification.

No. 709:—This example is a coarse grained, semi-crystalline limestone with a rather distinct bluish-grey tint: it is represented in Plate L, No. 8. The smoothed surface is bluish, and unlike most of the stones hitherto described it shows distinct large white dots; when wet it is seen to be composed of closely apposed, rather large fossil fragments with a small amount of brownish matter between. The etched surface is whitish grey with fine black lines. The fossil fragments are chiefly of *Bryozoa* and *Crinoids*. Like the stone from St. Francois de Salles described as No. 594 on page 71, this specimen shows a great number of minute spherical bodies scattered through the ground mass of the rock.

The physical characteristics are as follows:

Specific gravity	2.706
Weight per cubic foot, lbs	168.174
Pore space, per cent	0.444
Ratio of absorption, per cent, one hour	0.1062
" " " two hours	0.1062
" " " slow immersion	0.1432
" " " in vacuo	0.1432
" " " under pressure	0.1651
Coefficient of saturation, one hour	.64
" " " two hours	.64
" " " slow immersion	.87
" " " in vacuo	.87
Crushing strength, lbs. per sq. in., dry	20,860.
" " " " wet	13,910.
" " " " wet after freezing	13,350.
Transverse strength, lbs. per sq. in	2,710.
Shearing strength, lbs, per sq. in.	1,835.
Loss on corrosion, grams per sq. in	0.02453
Drilling factor, mm	9.3
Cl[illegible]g factor, grams	5.6

An analysis by Leverin of No. 706, page 75, gave the results there recorded. The present example is probably very similar in its chemical composition.

No. 708.—This sample is slightly coarser in grain than No. 709 and shows black fossil fragments at intervals.

No. 708b.—This rock is of still coarser grain and presents a highly crystalline structure with many of the calcite crystals stained red by oxide of iron. The crystalline and crinoidal nature of the stone and its uniformly red speckled appearance should give it a value as a marble.

No. 710.—This is a fine grained dark coloured rock almost as dark as No. 3 of Plate LI but of coarser grain. The stone is mainly composed of the little globular bodies already referred to: these are distinctly dark in colour and are cemented in a somewhat lighter matrix. Larger crystals of calcite are scattered throughout the mass. The little spheres appear to be made of a single crystal of calcite and do not show concretionary structure. They are probably to be ascribed to an organic (encrinal) origin.

No. 707.—This sample was selected from stone which had been cut and evidently represents a desirable variety. It is almost identical with No. 709 and is slightly darker than No. 708.

The haul from the quarry to Grande Ligne station is about two miles. There has been no production since 1908. The stone may be seen in the new part of the college at Grande Ligne, in other local buildings and in the post-office in St. Johns; it has also been shipped to Montreal.

Mr. — Otis, Rouses Point, Vermont.

This quarry is situated two miles north of Grande Ligne and about a half mile west of the Grand Trunk railway to which it is connected by a spur. The main opening is about 300 feet long and 150 feet wide; it is said to extend to a depth of 40 feet but the excavation was full of water at the time of my visit.

The beds dip a little to the east of north at an angle of about 15°. Strong vertical joints divide the formation due northwest and southeast at intervals which do not prohibit the obtaining of large blocks. A second, less defined set of joints runs due east and west and consequently cuts the major set at an angle of 45°. The beds are somewhat irregular, but on the whole, they are thick, with a probable maximum of about 3 feet. As far as could be judged from the layers now exposed, there seems to be a considerable variation in the character of the stone even within the same bed. The upper layer, at the southwest side, is blue in colour and is largely made up of broken shells (707), towards the northeast this bed is less uniform, with smooth argillaceous bands, wavy veinlets of calcite parallel to the major jointing, and large scattered crystals of pink calcite. It would be difficult to get good uniform building blocks from this bed. Some of the lower beds are of different character and yield a grey uniform crystalline stone (706).

The stone: No. 706.—This rock is shown in Plate L, No. 4; it is slightly lighter in colour but otherwise it is apparently very similar to No. 709 from St. George's quarry. As these two stones seem to differ considerably in their physical properties we must look to their structure as revealed in microscopic section or on etched surfaces for an explanation. To the naked eye there is little difference in the etched surfaces but on wetting and examining with a lens, the ground mass of No. 709 is homogeneous and filled with the little spherical concretions already referred to. On the other hand No. 706 shows a ground mass of lighter colour which is composed of minute fossil fragments and contains a much smaller number of the little concretions. No. 709 is evidently a much *cleaner* stone than No. 706. This structure is quite in accord with the higher pore space and ratio of absorption and lower crushing, shearing and transverse strength of No. 706, but it does not explain why the St. George stone should suffer so severely on wetting and freezing. It will be observed, however, that the latter stone has a higher coefficient of saturation under the immersion test. The physical properties are as follows:

Specific gravity	2.711
Weight per cubic foot, lbs	168.271
Pore space, per cent	0.571
Ratio of absorption, per cent, one hour	0.1482
" " " two hours	0.1482
" " " slow immersion	0.1771
" " " in vacuo	0.1948
" " " under pressure	0.2122
Coefficient of saturation, one hour	.7
" " " two hours	.7
" " " slow immersion	.83
" " " in vacuo	.96
Crushing strength, lbs. per sq. in., dry	19,180.
" " " " wet	19,160.
" " " " wet after freezing	16,000.
Transverse strength, lbs. per sq. in	2,210.
Shearing strength, lbs. per sq. in	1,325.
Loss on corrosion, grams per sq. in	0.0241
Drilling factor, mm	9.4

An analysis by Leverin gave the following results:

	per cent	
Insoluble matter	1.00	
Ferric oxide and alumina	.56	
Calcium oxide	53.5	equivalent to 95.53 per cent carbonate of lime.
Magnesium oxide	1.24	equivalent to 2.59 per cent carbonate of magnesia.
Combined water	.75	

No. 707. This example differs very little from No. 706 but it is slightly finer in grain.

The quarry is equipped with three derricks, steam hoists, steam drills and a good crushing plant. Twenty-five men were employed during 1911, but at the time of my visit in June 1912 operations had not been resumed. As far as could be observed, good building stone is less easily procured than in the quarries of St. George and Poirier.

Louis Perron, Grande Ligne, Que.

This property lies to the westward of the Otis holdings. The railway spur has been graded to the property but the rails have not been laid. The stone is similar to that of St. George and Poirier and was used for structural purposes many years ago. There is no production at present.

Edouard Poirier, Lot 16, Parish of St. Blaise, County of St. Johns.

This property is close to that of Alexander St. George which has been described above. There is no essential difference in the nature of the stone which is accessible over many acres in this vicinity. The quarry is small with only the upper layers removed.

Summary St. Johns-Grande Ligne Area.

Trenton limestones are exposed west of St. Johns, and the Chazy formation is accessible over considerable areas in the vicinity of Grande Ligne. Quarries were formerly operated for building stone in both localities but the only actual production is crushed stone from the St. Johns district. The Trenton stone is of the fine grained type for the most part, and is not comparable with the better grades of Trenton stone from the Montreal area. On the other hand, some of the Chazy stone from Grande Ligne is equal in quality to the semi-crystalline limestones from the Montreal area. Certain parts of the Grande Ligne beds are of reddish colour and coarse crystalline grain and would make creditable marble. A full account of the Trenton stone is given on page 71 and of the Grande Ligne stone on pages 73 and 75.

Literature: Geol. Sur. Can., Report 1894, p. 48 J.

ST. DOMINIQUE AREA.

The flat-country lying to the southward of the city of St. Hyacinthe is interrupted a short distance north of the village of St. Dominique in Bagot county by a prominent ridge of Chazy limestone which extends in a northeast direction for about four miles, with a width of a mile. On the road between St. Hyacinthe and St. Dominique a large number of quarries have been opened in this ridge and a large amount of stone has been removed. On the west side of the road from north to south the following operators succeed one another: Saint Ange, Albert, Brodeur, Dumas, Archambault. On the east side the owners are Grand Trunk Railway, Cornot, Lumière, Desgrange. A brief account of the stone in these various properties is given below.

Pierre Dumas, St. Dominique, Que.

The beds exposed on this property of 12 acres are thick with an average dip of 20° to the southeast. An opening near the road is small but it exposes a face of 15 feet showing very thick stone throughout. Strong joints run W. 20°N. with a southwesterly dip of 80°. These joints are very distinct with an average spacing of 4 to 6 ft. A diagonal set of joints running due east and west with a dip of 45° to the south is a rather bad feature. Fresh surfaces do not show much banding but on all the stone which has been exposed for a short time a most pronounced differential weathering in wavy bands is to be observed. Some of the stone is clean (831) but much of it is filled with white calcite veinlets (832).

About 100 yards farther west is another opening extending 150 feet along the strike. The major joints are as in the other opening: they are clean and straight about 4 feet apart. The east and west joints are not seen here, but there is a well defined set S. 40°W., with a 60° dip to the northwest. It might be said that the whole 15 feet of face is one bed, but there are incipient partings at intervals of 2, 3, and 4 feet. Blocks 13 by 9 by 4 feet have been removed. Calcite veinlets occur in certain parts of the beds.

The stone: No. 831.—This is a very fine grained, dark coloured limestone resembling No. 3, Plate LI. It is distinctly composed of two elements — a lighter very fine grained crystalline component and a darker, argillaceous portion in which crystalline structure is not observable with the hand lens. These two types of rock are mingled together throughout the beds in a very irregular manner, giving to the smoothed surface of the stone a characteristic mottled appearance by means of which the St. Dominique stone may be recognized very easily.

On corrosion the contrast between the two components is more pronounced. The dark part assumes a dirty brownish colour and the lighter portion shows the ordinary whitish grey colour with a fine "pepper and salt" effect, showing it to be composed of pulverized fossil fragments. In the dark part also are to be seen still darker lines which are probably due to bituminous matter. There is considerable evidence that the rock is a limestone breccia in which the lighter portions represent an original limestone which has been broken up and recemented in a dark argillaceous matrix.

The physical properties are as follows:

Specific gravity	2.762
Weight per cubic foot, lbs.	172.184
Pore space, per cent	0.209
Ratio of absorption, per cent, one hour	0.0068
" " " " " two hours	0.0089
" " " " " slow immersion	0.0333
" " " " " in vacuo	0.0518
" " " " " under pressure	0.0758
Coefficient of saturation, one hour	.09
" " " two hours	.12
" " " slow immersion	.44
" " " in vacuo	.68
Crushing strength, lbs. per sq. in., dry	26,150.
" " " " " " wet	25,900.
" " " " " " wet after freezing	21,800.
Transverse strength, lbs. per sq. in.	3,405
Shearing strength, lbs. per sq. in.	3,500.
Loss on corrosion, grams per sq. in.	0.01362
Drilling factor, mm.	6.3
Chiselling factor, grams (splintery, probably high)	8.5

An analysis by Leverin resulted as follows:

	per cent.
Silica	11.00
Ferric oxide and alumina	6.84
Calcium oxide	40.90
Magnesium oxide	4.92
Combined water	1.16
Carbonic acid and undetermined matter (by difference)	35.18

No. 832.- A hard fine grained, almost black limestone very similar to No. 831 but differing by being cut in all directions by veinlets of white and yellow calcite. It is a much less desirable stone than No. 831.

Six or seven men are commonly employed. Two hand derricks are installed. Rough stone is valued at $15 a toise. Good example of the use of this stone may be seen in the cathedral and in the public buildings in St. Hyacinthe (Plate IX).

Brodeur, St. Dominique, Que.

This property adjoins Dumas and contains 15 acres. The quarry is now abandoned. The old face along a length of 150 feet shows well the curving of the strata and the effects of the weathering.

St. Dominique limestone. Quarry showing jointing and weathering, St. Dominique, Que.

St. Dominique limestone. Municipal buildings and post-office, St. Hyacinthe, Que.

Mme. Lumière, St. Dominique, Que.

The Roman Catholic church has quarrying right on three acres of this property on the east side of the road. The beds exposed are higher than those already described and furnish a different kind of stone. The upper 12 feet are thin bedded (833) and are underlain by thicker beds up to 2 feet (834). The higher strata are used for lime making only and the lower layers for lime and for building. The quarries are small.

The stone: No. 833.—A very fine grained, compact, and light coloured limestone resembling the stone from the lower beds at Pointe Claire but presenting a much lighter colour. It has a slightly mottled aspect owing to the unequal distribution of patches in which the grain is coarser than in the general mass. This rock is probably of Lowville age.

No. 834.—Practically the same as No. 833 but slightly darker with a bluish tinge.

Alfred Cornot, St. Dominique.

This property succeeds the Lumière farm to the north. The beds belong to the upper series and have been worked to a very small extent.

Grand Trunk Railway.

The company formerly operated a large quarry on the face of the escarpment extending for 500 feet along the strike: it was worked back a distance of about 75 feet. The formation here seems to dip S. 40° E. at from 5° to 20.° Clean joints cut the strata S. 40° E., i.e. directly down the dip, and incline 80° to the southwest. The stone is disposed in very heavy beds similar to those described for Dumas' quarry. The quarry has been abandoned for many years.

E. Saint Ange; W. Daudelin, St. Dominique, Que.

On both these properties the lower stone has been quarried in heavy beds. On the latter a 15 foot face presents but one bed. Both quarries are out of commission at present.

O. Albert, St. Dominique, Que.

A small quarry is now being operated on this property at a point farther west than the others. The stone is essentially like those already described. The jointing here is remarkably clear and is shown in Plate VIII.

A derrick is erected and six men are employed.

Michel Archambault, St. Dominique, Que.

This property lies on the flat upland to the south and does not present a natural working face; in consequence the quarries have been opened for 500 feet along the formation and sunk to a depth of about 8 feet. In places the excavations are 100 feet in width. The lower stone is the typical heavy material, but it evidently represents the top of these strata as the thinner layers like those on the Lumière farm occur in limited amount at the surface. These upper layers, which may be regarded as contact beds between the two types of stone, are represented by No. 835 described below.

The stone: No. 835. This example is a very fine grained, light coloured, bluish stone resembling Nos. 833 and 834. The almost lithographic structure presented by these latter stones is not so pronounced in the present example as the fractured surface is slightly granular in appearance. The rock is cut by numerous roughly parallel veinlets of white calcite and this mineral also occurs on the joint planes of the formation.

Summary—St. Dominique Area.

Chazy limestone has been quarried in large amount from a ridge of stone which crosses the country in a northeasterly direction some miles south of the city of St. Hyacinthe. The building stone beds are very thick and capable of yielding stone of any reasonable dimensions. The stone is of dark colour and fine grain: it shows two components of different colour and texture which are mixed together in an irregular manner. As these components possess different degrees of resistance to the weather, the stone rapidly assumes a mottled appearance which is very characteristic. A full description of a typical example is given on page 78.

Towards the south of the exposure the building beds are overlain by a fine grained, whitish limestone which probably belongs to the Lowville formation. This stone is used for lime burning only.

JOLIETTE AREA.

The Trenton and Black river formations in which are situated the quarries of St. Vincent de Paul and St. Francois de Salles continues as a comparatively narrow belt of varying width to Pointe aux Trembles, about 25 miles above Quebec, where it is interrupted by strata of the Lorraine formation. Good limestone doubtless occurs throughout this belt, but the country is so deeply covered by drift that workable exposures are by no means frequent. Three areas may be recognized, of which the first is that in the vicinity of Joliette in Joliette county, the second is a scattered area extending from St. Cuthbert in Berthier county to St. Justin in Maskinongé county, and the third the famous region at St. Marc des Carrières in Portneuf county.

The Joliette quarries proper are situated on both sides of the river near the town. Other quarries about 1½ miles from Joliette in the parish of St. Paul are included in the area. Ells mentions also a quarry now abandoned 4 miles northeast of Joliette and states that desirable stone crops out along the Chaloupe river.[1]

Edouard Lauzon, operator, Mme. Leprohon, owner, Joliette, Que.

This quarry is on the east side of the river at Joliette: it forms the southern part of an excavation which is continuous with that of Beaudry described below. The quarry is almost 180 feet long and has been worked back from the river to a distance of 50 feet.

The section is as follows:—

Stripping, slight.

22 ft.—Thin bedded limestone; showing alternations of light and dark stone in layers of lenticular character. In places stone a foot thick can be procured.

7 ft.—Building beds to level of river. A 20 inch bed occurs at the top, then a 4 foot bed. The stone is of uniform light grey colour and crystalline texture: it shows very few black bands but has rather large fossil fragments in places. This stone, of which a considerable supply is still available, can easily be quarried in large blocks.

The stone: The better type of stone from this quarry is the same as that from Desroches' quarry described below as No. 599.

The upper beds only were being worked at the time of my visit. About 90 tons a day were being quarried and crushed for use by the corporation of the town of Joliette. Six or seven men are employed. M. Lauzon operates anot[illegible] quarry in the parish of St. Paul about 1½ miles from Joliette wh[illegible] tone approaches the [illegible]urface over a considerable area. The quarry [illegible] 500 feet long in a southwest direction with a width of 100 feet. [illegible] the southwest end, an upper bank of only a few feet deep is being worked, but at the northwest end a face of 20 feet is exposed with a section as follows:—

4–5 ft.—Thin bedded and black banded limestone.

2–4 ft.—Grey building stone (601).

13 ft.—Thin bedded hard black stone (600).

The stone: No. 600.—This is a very rough and dark coloured stone, consisting in part of crystalline material and in part of almost black calcareo-argillaceous matter. It is fossiliferous and subject to very irregular fracturing.

No. 601.—This stone resembles the brownish crystalline variety from the quarries at Joliette, to be described later as No. 599, but it is slightly darker as shown in No. 2 of Plate L. The corroded surfaces of the two examples are also very similar but No. 599 shows a dark spotted appearance due to crystal fragments which is almost absent in No. 601: this may account for its much higher porosity and drilling factor. The physical properties are given below:—

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[1] Geol. Sur. Can., Report 1898, p. 161 J.

Specific gravity	2.691
Weight per cubic foot, lbs	163.326
Pore space, per cent	2.775
Ratio of absorption, per cent, one hour	0.302
" " " two hours	0.321
" " " slow immersion	0.704
" " " in vacuo	0.73
" " " under pressure	1.06
Coefficient of saturation, one hour	.285
" " " two hours	.33
" " " slow immersion	.663
" " " in vacuo	.685
Crushing strength, lbs. per sq. in., dry	15,350.
" " " " wet	13,610.[1]
" " " " wet after freezing	14,540.
Transverse strength, lbs. per sq. in	2,320.
Shearing strength, lbs. per sq. in	1,130
Loss on corrosion, grams per sq. in	0.03184
Drilling factor, mm	16.7
Chiselling factor, grams	10.

The product of the quarry is used for lime burning and for concrete. A steam pump is installed as well as a quantity of track and a number of cars. Eight men are employed.

Pierre Beaudry, operator; Mme. Leprohon, owner, Joliette, Que.

This quarry is continuous with that of Lauzon to the northward: it is about 200 feet long and 50 feet wide. The section is the same as that given above. An indistinct set of joints runs E. 25°S. and dips 80° to the northward. Other less distinct joints also occur. The upper stone is worked for lime with the occasional use of the thick layers for foundations. The lower building beds are not being exploited but a small amount of cut stone has been made from them.

George Desroches, operator; Mme. Leprohon, owner, Joliette, Que.

On the west side of the river opposite the properties described above, a large excavation extends from the bridge southward. It has a width of about 200 feet and reaches to within 90 feet of the south end of the property. The face presents the following section:—

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[1] This factor is evidently too low, but the test seemed quite satisfactory.

2-10 ft.—Stripping,
12 ft.—Thin stone,
2 ft.—Building bed,
5 ft.—Building bed.

The beds dip S. 10°E. at a low angle. The joints are irregular but not numerous or close set: large blocks are easily obtained. The good building beds will pass below the level of the water if the excavation is extended to the adjoining property on the south. The upper building bed and the upper part of the five foot bed, are the most desirable (599). The lower part of the heavy bed is banded, somewhat harder, and marred in places by scattered fossils.

The stone: No. 599.—This is a medium grained, semi-crystalline limestone with a brownish colour; it is shown in Plate L, No. 3, and seems to be composed almost entirely of fossil fragments. After etching, the general appearance is whitish grey with dark dots. The white portions are the remains of *Bryozoa* for the most part, while the dark spots represent the crystalline remains of encrinites. A few scattered patches of pyrite were observed.

The physical properties are as follows:

Specific gravity	2.705
Weight per cubic foot, lbs.	167.271
Pore space, per cent	0.944
Ratio of absorption, per cent, one hour	0.253
" " " " " two hours	0.264
" " " " " slow immersion	0.3025
" " " " " in vacuo	0.313
" " " " " under pressure	0.353
Coefficient of saturation, one hour	0.717
" " " two hours	.748
" " " slow immersion	.857
" " " in vacuo	.888
Crushing strength, lbs. per sq. in., dry	16,030
" " " " " " wet	14,130.
" " " " " " wet after freezing	13,850.
Transverse strength, lbs. per sq. in.	2,187.
Shearing strength, lbs. per sq. in.	1,000.
Loss on corrosion, grams per sq. in.	0.03
Drilling factor, mm.	12.4
Chiselling factor, grams	7.8

Analysis by Leverin:—

	per cent.
Insoluble matter	0.64
Ferric oxide and alumina	0.48

Calcium oxide.............	54.35 equivalent to 97.05 per cent carbonate of lime.
Magnesium oxide...........	0.26 equivalent to 0.54 per cent carbonate of magnesia.

This stone contains the highest percentage of carbonate of lime, and the lowest percentage of magnesia of any of the stones tested. It is interesting to note that the St. Marc stone which this example so closely resembles has an almost identical composition. Rough blocks are valued at 45 cents per cubic foot delivered in Joliette. Shoddy is sold at $3 per square yard, f.o.b. Joliette. Two derricks are installed. Five quarrymen and as many stonecutters were employed in 1912. The output varies greatly. The stone may be seen in the college buildings, church, convent, orphan school, hospital and post-office in Joliette; and in the normal school on Sherbrooke street near Montcalm street, Montreal. In all the buildings of this stone the grey colour is clean, uniform and well preserved. Planes of bedding are not observed except in some poor blocks from the lowest bed. Bush-hammered work remains smooth and uniform and there is little tendency for the colour of the rock-face and hammered stone to lose the original contrast. In its uniformity and in the absence of wavy clay partings this stone is superior to that of St. Vincent de Paul and St. Francois de Salles.

Joliette Limestone Company, Joliette, Que.

This company formerly quarried between Joliette and Lauzon's quarry in St. Paul at a point about one mile southwest of Joliette. Owing to the increasing overburden, operations were suspended and the company now purchases stone for lime burning from Lauzon.

Summary—Joliette Area.

On both sides of the river at Joliette a high grade limestone is found beneath a heavy covering of stone of inferior quality. The upper stone is quarried for lime burning and for macadam, and the lower beds are employed for structural purposes. South and west of Joliette stone of the poorer type mixed with beds of good quality are quarried on a rather extensive scale for lime burning and other purposes.

The building stone is a semi-crystalline variety with a slightly brownish cast not seen in the stone from the areas already described. It is more porous than the Montreal stone but it is much more free from the objectionable shaly partings. The Joliette stone is very similar to the product of the quarries at St. Marc des Carrières. The physical properties of the stone are indicated in the tables on pages 82 and 83.

Literature: Geol. Sur. Can., Report 1898, p. 61 J.

ST. CUTHBERT AREA.

Trenton limestone has been quarried in a small way at several points in the counties of Berthier and Maskinongé, chiefly in the beds of small rivers where the heavy drift has been removed by erosion. The quarries have been worked for lime burning and for foundation stone and in each instance the church and other buildings connected therewith have been built of the product of the local quarry. The localities mentioned by Ells are St. Cuthbert, St. Barthélémi and St. Justin. Farther east, in the seigniory of Cap de la Magdelaine, limestone has been quarried at Radnor Forges. As all these quarries are small and as none of them are now in operation a description of those at St. Cuthbert will suffice for the purpose of this report.

Gaspard Desfonds, St. Cuthbert, Que.

A heavy mantle of drift covers the rock in the vicinity of St. Cuthbert. The rock surface is very irregular, however, allowing an occasional outcrop to reach the surface. The only exposures that have been exploited occur in the erosion valley of the Chicot river at St. Cuthbert.

Three outcrops have been quarried in a distance of about a quarter of a mile. The upper exposure shows the following beds in descending order:—

10-12 ft.—Drift which would rapidly increase if the quarry were extended.

4 ft.—Dark bituminous limestone in heavy beds but with irregular flaky structure and argillaceous inclusions (907).

10 ft.—Even grained limestone of building quality (906): occasional chert nodules occur in the lower part but the upper layers are good.

15 ft.—Hard limestone with many nodules of chert. The beds are irregular but sometimes thick. Silicified fossils are common on the bedding planes making the partings rough.

The formation strikes about east and west and dips 10° to the south. The joints are widely spaced and strike N. 40° E. with a northwesterly dip of 80°. Cross joints are irregular but they are of infrequent occurrence. The dip of the beds and the heavy overburden would make the opening of a large quarry at this point a rather hazardous undertaking.

The second opening which has been more extensively worked, probably lies at a higher level geologically than that described above. The formation strikes E. 30° N. and dips 10° to the southeast. The face of the quarry extends about 100 yards in a northeasterly direction with the working face advancing down the dip. The following succession of beds is presented:—

Drift, slight at present but would rapidly increase.

10 ft.—Thin, shaly, fossiliferous limestone.

7 ft. 6 in. Building limestone, medium quality in variable beds.
16 in. Good persistent bed of excellent quality (908).
8 in. Like above.
17 in. Like above.

The joints are clean and vertical at convenient intervals, S. 20 W. and at right angles to that direction.

The third quarry is on the opposite (west) side of the river near the water level. Denudation has reduced the heavy layer of drift to a thickness of 6 or 8 feet over a limited area. The beds exposed are as follows:
2 ft. Good even grained building beds (909).
10 in. " " " " "
5 ft. Stone resembling the above in heavy beds, but disfigured by the presence of many black irregular shaly partings (910).

A short distance farther down the river the upper shaly beds are again exposed on the opposite side of the stream. It would appear therefore that the general succession for all three openings is as follows:
Upper thin shaly beds.
Middle good building beds.
Lower cherty beds.

At each of the three quarries good stone may be obtained from the middle beds, but in each instance the rapidly increasing overburden would make quarrying operations more and more expensive.

The stone: No. 906.—A grey, highly crystalline, fine to medium grained limestone. Fresh fractures show white and glistening facets owing to a minimum of non-crystalline matter between the calcite crystals. The flakes are white and transparent. The specimen shows a slight amount of banding in darker tones. An analysis of this stone gave Leverin the following results:

	per cent.	
Insoluble matter............	0.35	
Ferric oxide and alumina....	0.24	
Calcium oxide.............	54.9	equivalent to 98.03 per cent carbonate of lime.
Magnesium oxide..........	0.39	equivalent to 0.82 per cent carbonate of magnesia.
Combined water............	0.7	

It will be observed from the above that this is a very pure limestone.

No. 907.—This sample is very different from the above as it presents a fine grained dark muddy base with large fossil shells. Secondary calcite crystals occur throughout the matrix and in places are aggregated into white spots. It is a much less desirable stone than No. 906.

No. 908.—A semi-crystalline rather coarse grained brownish limestone resembling the variety from Joliette described as No. 599 on page 83.

No. 909. This stone resembles No. 906 but it is slightly coarser in grain, less thoroughly crystalline, and darker in colour.

No. 910. Very like No. 906, but has a slightly finer grain with less of the thoroughly crystalline structure. The dark bands are more sharply defined and farther apart.

The church, convent and college of St. Cuthbert are built of the local stone. All these buildings show that the stone weathers to a soft pleasing grey and retains chisel marks remarkably well. The variation in the stone from different beds is quite pronounced in the rock-face work but it is much less perceptible in the bush hammered blocks. The variation in the blocks detracts greatly from the appearance of the church, which was built about 34 years ago, and the same defect is seen in the college which is about 16 years old. In this latter building the front, which is evidently built of more carefully selected stone, presents a much more uniform appearance.

ST. MARC DES CARRIÈRES AREA.

Extensive quarries in the Trenton limestone have been worked for many years in the vicinity of St. Marc des Carrières in Portneuf county. The product of these quarries has been used extensively in Quebec and Montreal under the name of Deschambault stone: it is also referred to as Portneuf stone. The quarries are connected by a siding with the Canadian Northern railway which is about half a mile distant. The Canadian Pacific railway is 2½ miles away and the new line of the National Transcontinental passes close to the quarries.

With regard to this area Ells states: "At St. Albans bridge the gorge of the St. Anne river for half a mile above and for two miles below, passes through these rocks, and any amount of good stone may be obtained here. The stone is light grey in colour, with a yellowish tint, and is finely granular in texture.

"In the rear of the fourth and front of the fifth range of La Chevrotière, extensive quarries have been worked for a number of years in beds of nearly the same horizon as above. The stone has a yellowish grey colour of even tint, and is not readily decomposed on weathering. Its texture is more granular than the Montreal stone but it does not take so fine and sharp an edge, nor does it pick out so well. This stone has been used extensively for the large public works of Quebec, and is drawn from the quarries some two miles to the railway. The quarries owned by some seven individuals, or companies, are opened on both sides of the St. Alban road for a distance of over a mile. The beds worked are only four or five in number, and as they lie nearly flat, and are near the surface, the quarries are only a few feet deep. The greatest thickness obtained here is 6 ft. 3 in., but this bed is liable to break into beds of 3 ft. 6 in., and 2 ft. 4 in., above this is another of nearly 3 ft. thickness overlaid by beds of 2 ft. and 15 in. in thickness. To the south of this locality in the second range, smaller quarries have been worked in the past, but are now [illegible]; the stone here, although hard and massive is penetrated by thin partings of black shale, which soon weather on exposure and give the stone a rough appearance.

"At Pointe aux Trembles, extending over several lots, there is a grey limestone in massive beds, in which quarries have been worked. It has a colder tint than the stone of La Chevrotière and is less granular, it is not soft, but can be worked to a sharp edge. The beds yield good large blocks, and the stone has been used in Quebec for the construction of the Champlain market and other public buildings."

Concerning these quarries the following quotation is also of interest. "The Trenton limestones have a great development at St. Alban, where are found the well known quarries which yield the best building stone of the province of Quebec. The limestone is crystalline and fossiliferous. The quarries yield annually from four to six thousand toises of stone."[2]

The chief operators at St. Marc are
Geo. Chateauvert et Cie.
La Compagnie des Carrières,
Joseph Gingras,
Deschambault Stone Co.,
Elzeard Laforce,
Damase Naud,
M. Gautier.

Geo. Chateauvert et Cie., St. Marc des Carrières, Portneuf county.

This company holds [illegible] acres at St. Marc. Quarries have been worked over about 15 acres but a large amount of stone is still available. The working face is about 900 feet long. The section is as follows:

0-7 ft.—Soil, mostly 18 to 24 in.
1 ft.—Limestone bed.
18-24 in.—Limestone bed.
3 ft. 6 in.-5 ft.—Limestone bed.
1 ft.-22 in.—Limestone bed.

It will be observed from this section that the beds vary somewhat in thickness. The major joints strike due northwest with a vertical dip. Cross joints are infrequent but occur occasionally at right angles to this direction. The extraction of the stone is much assisted by this favourable jointing. Blocks of 100 to 125 cubic feet are frequently raised (Plate X).

The stone is very similar in all the beds, the only variation being in the relative abundance of fine wavy black lines. In places these lines are scarcely to be observed but in others they show more prominently. To-

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[1] Geol. Sur. Can., Report 1890-91, p. 69 L.
[2] Geol. Sur. Can., Report 1886, p. 37 A.

St. Marc des Carrières limestone. Quarry of Georges Chateauvert et Cie., St. Marc des Carrières, Que.

wards the bottom of the quarry the stone is somewhat darker with a greater amount of this black streaking this lower stone is not used for the finer types of buildings. A typical example of the best stone is described in detail below as No. 575. As little variation is shown in all the quarries on the range this description will apply equally well to the other properties.

The stone: No. 575. This limestone is of medium grain and light brownish colour; it is shown in Plate L., No. 1. The colour is lighter than that of any other of the well known Quebec stones of the medium to coarse crystalline class. A comparison of the figures of Plate L. shows that this stone resembles the varieties from Joliette (Nos. 2 and 3) much more closely than it does any of the stones from the Montreal area. The etched surface shows the usual whitish grey aspect, with the lighter portions, representing non-crystalline calcareous organisms, rather prominent. The tests show that this stone is superior to the Joliette varieties in nearly every respect. It is weaker and has a greater porosity than the average of the Montreal stones but on the other hand it should be worked with greater facility. The physical tests resulted as below:

Specific gravity	2.703
Weight per cubic foot, lbs.	167.654
Pore space, per cent	0.642
Ratio of absorption, per cent, one hour	0.139
" " " " " two hours	0.139
" " " " " slow immersion	0.202
" " " " " in vacuo	0.209
" " " " " under pressure	0.239
Coefficient of saturation, one hour	.582
" " " two hours	.582
" " " slow immersion	.847
" " " in vacuo	.875
Crushing strength, lbs. per sq. in., dry	17,980
" " " " " " wet	17,220.
" " " " " " wet after freezing	14,230.[1]
Transverse strength, lbs. per sq. in.	2,685.
Shearing strength, lbs. per sq. in.	1,750.
Loss on corrosion, grams per sq. in.	0.0265
Drilling factor, mm.	12.9
Chiselling factor, grams	6.2

An analysis by Leverin gave:—

	per cent.
Insoluble matter	0.30
Ferric oxide and alumina	0.40

---

[1] This figure is probably too low as the test tube yielded on one side before the general collapse.

Calcium oxide...	.... 54.30	equivalent to 96.96 per cent carbonate of lime.
Magnesium oxide.	.... 0.28	equivalent to 0.58 per cent carbonate of magnesia.

The stone from these quarries as well as that from the other quarries on the range is said to work very easily as regards both splitting and chiselling. In quarrying it is found that plug holes 3 inches apart and 6 inches deep suffice for the parting of the heaviest beds 15 feet back from the face. A slab of one foot in thickness can be split by 2½ in. plug holes 10 inches apart.

In rock-face work the stone appears a little dark at first but it soon assumes a lighter colour. The hammered work is much lighter than the rock-face and presents a pleasing contrast. The most unfortunate feature, as in the case of the Montreal stones, is the presence of wavy bituminous or clayey partings. Selected stone can be obtained, however, in which these lines are present in scarcely appreciable amount.

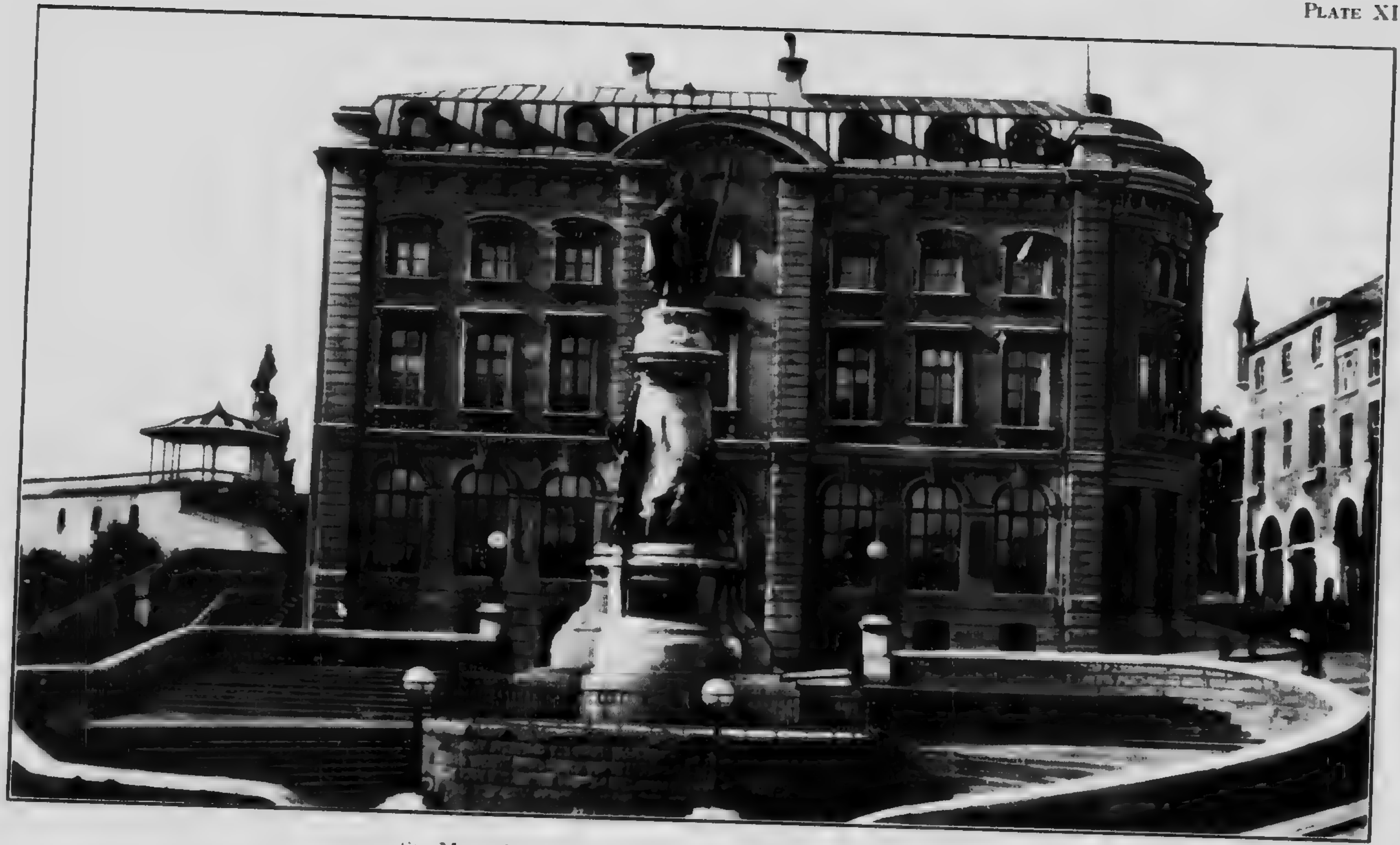
The company is prepared to deliver stone of all reasonable dimensions, rough, sawn, or dressed to order. The equipment is as follows:-

Mill building, 40 feet square.
Two gang saws, Lincoln Iron Works, Rutland, Vt.
One planer, Lincoln Iron Works, Rutland, Vt.
One lathe, Lincoln Iron Works, Rutland, Vt.
One 50 h.p. engine and boiler.
One compressor.
Three steam drills.
Two air drills.
Two pneumatic tools.
Frenier sand pump and distributors.
Four plug drills.
Two horse derricks.
Two steam derricks.
One hand derrick.
One engine and boiler for
One 6½ in. centrifugal pump.

Ninety-five stonecutters and thirty quarrymen and labourers are employed. The efficiency of the gang saws is about four inches per hour on large blocks. Besides being used for building purposes the stone is sawn into slabs for table tops, counters, etc. It is said to be capable of a fair degree of polish.

M. Chateauvert quotes the following prices:—
Rough blocks, 50 to 55 cents per cubic foot, f.o.b. quarry.
Ashlar, bushed, 7 or 8 in., 65 cents per lineal ft., f.o.b. quarry.

PLATE XI.



St. Marc des Carrières limestone. Post-office, Quebec, Que.

Cut shoddy, rock face, \$3.50 to \$3.75 per sq. yard, f.o.b. quarry.

Sills, two brick, rock face, bedded, bushed top, 75 cents per ft., f.o.b. quarry.

The production in 1911 was 150,000 cubic feet.

Stone for the construction of the post-office in Quebec (Plate XI) was hauled from these quarries a distance of 50 miles into the city. Among the numerous buildings in which this stone may be observed may be mentioned:

Armouries, Toronto.
Armouries, Kingston.
R.C. church, Webster, Mass, U.S.A.
Parliament buildings, Quebec.
New library of parliament buildings, Quebec.
City hall, Quebec.
Y.M.C.A. building, Quebec.
Laval university, St Denis street, Montreal.
Polytechnic school, St. Denis St., Montreal.
Mount Royal club, Sherbrooke street, Montreal.
École des Hautes Études Commerciales, St. Hubert and Viger streets, Montreal (Mr. Chateauvert considers this building the finest example of the stone).
St. Henri church, Montreal.

Deschambault Stone Co., Joseph Paquin, president, St. Marc des Carrières, Quebec.

The quarry on this property is quite small with a face about 50 feet long: the beds are exposed as follows:—

1 ft.—Limestone bed
20 in,—Limestone bed } These two beds are sometimes united.
20 in.—Limestone bed }
2 ft.—Limestone bed
1 ft. 6 in.—Limestone bed

The major joints, as in the Chateauvert quarry are about southeast in direction and from 4 to 5 feet apart. A second set, southwest, is less well developed and somewhat crooked: these are usually from 10 to 15 feet apart. The stone in all the beds is essentially the same and does not differ from that described from the Chateauvert quarry.

This company produces neither rubble or ashlar but converts all its product into cut stone. The equipment consists of a boiler, one derrick, with steam hoist and a steam drill. Thirty men are employed. Eight inch sills are quoted at 65 cents, and 4 inch sills at the same rate, f.o.b. quarry.

The stone may be seen in the church of Notre Dame des Sept Douleurs, Verdun, Montreal.

La Compagnie des Carrières de St. Marc.

The quarry on this property presents a semicircular working face of about 200 feet. Where fresh the face shows 2 to 6 feet of stripping, an upper bed of 4 feet which is somewhat shattered, and a lower bed of 5 feet. In other parts where the face is more weathered the beds are 18 in.; 2 ft.; 3 ft. 3 in.; and 1 ft. 10 in. The jointing is the same as in the other quarries. Blocks 10 ft. by 5 ft. by 1 foot in thickness have been quarried. A piece containing 90 cubic feet was used for cutting the cross for St. Elizabeth church, Montreal.

The equipment consists of one 20 h.p. gasoline engine, one compressor, one pump, four air drills (1 rock, 3 plug) and two derricks. Thirty quarrymen and 35 stonecutters are employed. About 45,000 cubic feet a year are quarried. Prices quoted are essentially the same as those already given. The stone may be seen in the Windsor station, Montreal, St. Elizabeth church, Montreal, and in the new school in Quebec.

Joseph Gingras, St. Marc des Carrières, Que.

In this quarry the present face is about 100 feet long. The section shows:—

6–8 ft.—Stripping.
2 ft.—Good bed of light stone.
3 ft. 6 in.—Good bed of light stone.
3 ft. 6 in.—Good bed of light stone.
3 ft. 6 in.—Darker stone not usually removed.

The equipment consists of one steam derrick, one horse derrick, one gasoline engine, one compressor, one rock drill, and two plug drills. Twenty-five cutters and 15 quarrymen are employed. The stone may be seen in the offices of the Electric company in Quebec, Quebec Bank in Quebec, and in the Carnot block, Quebec.

Damase Naud, St. Marc des Carrières, Que.

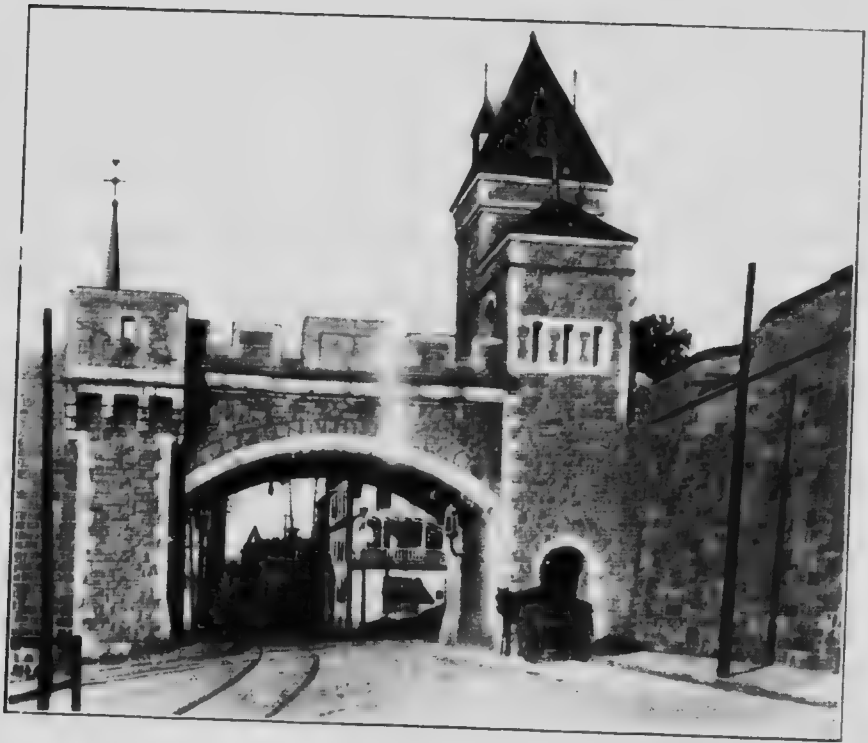
M. Naud operates two quarries. The northern property consists of 60 acres but only 5 acres are unquarried. The excavations have been worked to a depth of 5 feet only on account of the difficulty of unwatering. Two derricks are installed here.

The south property consists of 40 acres, of which 30 acres remain unworked. The section shows 3 feet of soil, beneath which the limestone beds occur in layers of 2 ft., 1 ft., 3 ft., and 18 inches.

The equipment comprises one steam derrick, four small derricks, one steam pump, and two gasoline engines. The force consists of 125 men of whom 80 are stonecutters. 50,000 cu. ft. per year are produced.

Stone from this quarry may be seen in the church of St. Stanislas, Montreal, the post-office at Rigaud, and the school at Rosemont.

PLATE XII.



Sillery sandstone and St. Marc limestone. St. Louis gate, Quebec, Que.

Elzeard Laforce, St. Marc des Carrières, Que.

On this property the stripping averages 2 feet and the limestone beds occur in layers of 18 inches, 1 foot, 2 feet, and 18 inches to 2 feet.

The equipment is one engine and boiler, one compressor, two plug drills, one rock drill, and two horse derricks. About 10,000 cu. ft. per year are produced. Eight men are employed.

M. Gautier, St. Marc des Carrières, Que.

This property has been recently opened as a quarry; it lies to the south of M. Naud's northern quarry.

Summary—St. Marc des Carrières Area.

On the St. Alban road in La Chevrotière, Portneuf county, the Trenton limestones come close to the surface and are represented by several beds of semi-crystalline, brownish grey limestone which by some authors is considered the finest building stone produced in the Province of Quebec. Extensive quarrying operations have been carried on here for many years and a large amount of dressed stone has been shipped to Quebec and Montreal and to other points at a greater distance. Nearly all the cut stone observed in the city of Quebec has been derived from these quarries, some of it having been hauled fifty miles into the city before the construction of the Canadian Pacific railway. A detailed description of a typical example of the stone is given on page 89. A comparison of the table of physical properties there given with the general average of the Montreal stones given on page 70 shows that the St. Marc stone is somewhat lighter in weight with a slightly higher pore space. It would appear, however, that its coefficient of saturation is lower, indicating a greater power of resistance to the action of frost. The crushing and transverse strengths are lower than in the Montreal stone and, as indicated by the drilling factor, the present example should be somewhat easier to cut. The colour of the St. Marc stone is lighter than that of the Montreal type and shows a cast of brown.

Compare Nos. 1 and 12 of Plate L.

Literature: Geol. Sur. Can., Report 1890–91 p. 69 L.
Geol. Sur. Can., Report 1888–89 p. 126 K.
Geol. Sur. Can., Report 1886 p. 37 A.

BEAUPORT-CHÂTEAU RICHER AREA.

Eastward from the city of Quebec the Trenton limestones crop out at various places as far down as Château Richer. Quarries have been worked at many points but more particularly at Beauport and Château Richer. From Beauport eastward to the Montmorency river the strata of this formation extend about four miles inland and have been worked for lime burning and for foundations at a great many points. A full account of the geology of the region is given by Ells in Part L of the Report of the Geological Survey of Canada for 1890-1. The most interesting statement from the present point of view is the following:

"On the outcrops of limestone from St. Ambroise eastward to Beauport, numerous small quarries have been opened and a large quantity of stone extracted for burning into quick-lime and for road metal. This stone is generally dark in colour, without a good granular structure and is generally divided by thin beds and partings of black bituminous shale, so that no blocks of any considerable thickness are obtainable.

"At Beauport, building stone of moderate dimensions is taken from large quarries on the hillside behind the village. This stone is of the same description as the above, and is used for private dwellings in and around Quebec. In rear of Beauport to the Montmorency river, small quarries and accompanying lime kilns are seen on nearly every farm lot. The limestone here is thin bedded and greatly mixed with shale, and is useful only for lime burning.

"At Château Richer there are nine quarries in operation. The limestone, similar to that of Beauport, but of a better quality, is being preferred by builders in the construction of private buildings in Quebec."

CHÂTEAU RICHER GROUP.

The Trenton limestones are folded over a spur of Pre-Cambrian rocks at Château Richer in Montmorency county about 15 miles below the city of Quebec. At the bottom of the hill the strata strike due east and west with a dip of 22° south. This dip gradually decreases as the hill is ascended until a horizontal position is assumed. A belt of comparatively level strata is thus presented beyond which there is a slight northward dip followed by an abrupt ascent in which the beds dip 40° to the south. The whole hill is probably 150 feet high and thus presents excellent opportunities for quarrying, which has been carried on for many years. At present nearly all the product is crushed, but formerly large quantities were used for buildings as in the forts at Levis. The major joints run with the strike, east and west. The jointing is clean but the two series are not at right angles. This system of fracturing is not maintained throughout the exposure: in other places, two vertical sets were observed at N. 30°E. and N. 35 W. The stone is very much alike in all the quarries being disposed in thin beds with shale partings. Stone six or eight inches thick must be regarded as representing the general maximum but occasionally layers are encountered from which coursing 10 inches thick might be cut.

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[1] Geol. Sur. Can., Report 1890-91, p. 70 L.

The quarries extend for about a mile along the river eastward from Château Richer. The names of the operators with the number of men employed are given below:

Baker company 25 men.
A. Lachance 4 men.
F. Verreault 3 men
X. Trepanier 4 men.
L. Gravel 4 men.
H. Gravel 5 men.
F. Gravel 5 men.
O. Falordo 5 men.

The Baker company has an engine and small crusher, also a boiler and steam drill. The smaller operators are quarrying by hand labour alone.

The stone: No. 570.-- In the quarry the stone is seen to present a dark portion and a lighter portion which are banded together. Uniform beds of either colour are rare. In many places the strata are transversed by fine white calcite stringers. Although the product of these quarries has been used for construction it can not be regarded as a building stone of fine quality. On exposure the stone assumes a much lighter colour. The present example is somewhat lighter in colour than the stone from the Quebec Brick Company's quarry described as No. 574. It represents the lighter and more solid part of the beds and is divided into thin layers by black clayey and somewhat bituminous matter.

The stone is valued at 80 cents per cubic yard loaded at the wharf. The output is roughly estimated at 50,000 yards a year. Stone from Château Richer may be seen in the rear of Laval university and in St. Peters church (Anglican) in Quebec.

BEAUPORT GROUP.

Trenton limestones are exposed at Beauport in Quebec county about 5 miles east of the city of Quebec. The strata resemble those at Château Richer but differ in their horizontal or slightly undulating position.

Francois Parent, Beauport, Que.

The strata on this property are practically horizontal but are disposed in a very gentle syncline with a north and south axis. The quarry is opened for a distance of 600 feet along this axis with a width of about 200 feet. The rock surface has been eroded so that the face is 20 feet high at the south and 50 feet high at the north, although the floor is level. Further extension northward will not increase the height of the face. The jointing is very irregular and rather severe. The use of large charges of dynamite has made it impossible to make out regular joint systems.

The stone is much alike throughout and is uniformly thin bedded presenting two inch bands of lighter and darker colour. It is possible to obtain fairly thick stone by the coalescence of the beds but there is always a strong tendency to part along the banding. The bedding is somewhat wavy but blocks would not require much dressing for rough building.

The stone: No. 573. This example is like Nos. 570 and 574 but it is less uniform as the extremely fine grained black component is mingled in streaks and bands with a lighter finely crystalline variety.

Nearly all the product is crushed but a little is sold for rubble and for use in foundations and rough walls. The stone is valued at $4 per cord at the quarry. The average output is said to be $50,000 per annum. A small crusher is installed. Twenty men are employed.

Quebec Brick Company, Jean Tanguay, president, Quebec, Que.

On the property adjoining Parent to the east an old quarry was worked to a depth of 8 feet over a considerable area. The new quarry now being worked by the company is about 300 feet by 100 feet and presents a face of 50 feet to the level of the old workings. The strata are practically horizontal thus presenting a good working floor. The stone is the same as in Parent's quarry: in the more solid parts it may be obtained to a thickness of 18 inches but there is always a strong tendency to split on the bedding. A selected sample of the best grey stone is described as No. 574: it is to be remembered that the average run of the quarry is a much less desirable material.

The stone: No. 574.—This stone is dark brownish grey in colour and very fine in grain: it is shown in Plate LI, No. I. Smoothed surfaces have a bluish tinge which is entirely lost on corrosion as this operation results in the production of a dirty, whitish brown colour without any [illegible] the speckled effect seen in the more crystalline stones. The veinlets which traverse the rock become more pronounced by assuming a lighter colour.

The physical properties of the stone are given below:—

Specific gravity	2.706
Weight per cubic foot, lbs.	168.283
Pore space, per cent	0.38
Ratio of absorption, per cent, one hour	0.0114
" " " " " two hours	0.0343
" " " " " slow immersion	0.0636
" " " " " in vacuo	0.0973
" " " " " under pressure	0.1425
Coefficient of saturation, one hour	.08
" " " two hours	.243
" " " slow immersion	.444
" " " in vacuo	.682

Crushing strength, lbs., per sq. in., dry	44,400
" " " " " wet	35,080
" " " " " wet after freezing	31,680
Transverse strength, lbs. per sq. in.	3,520
Shearing strength, lbs. per sq. in.	3,380
Loss on corrosion, grams per sq. in.	0.0154
Drilling factor, mm.	6.6
Chiselling factor, grams.	5.3

This stone has the highest crushing strength of any of the Quebec limestones tested: with one exception it has a higher crushing strength than any of the igneous rocks.

Quarrying is effected by the use of large charges of dynamite whereby the stone is much shattered. Two Temple-Ingersoll electro-air drills are employed. The crushing plant is operated by electricity: it contains one No. 7½ and two No. 3 Austin crushers. The total capacity is said to be 800 tons a day but the average production is 360 tons. A siding from the Quebec Railway, Light and Power Company affords excellent shipping facilities. Forty men are employed.

Building stone is valued at $1 per cubic yard, f.o.b. quarry, and crushed stone at 85 cents per cubic yard. The company was engaged in filling a $200,000 contract for the city of Quebec at the time of my visit.

Summary Beauport-Château Richer Area.

From the point of view of the present report this area can not be considered of great importance as the stone is all of the thin bedded dark coloured variety of Trenton limestone which is suitable for buildings of a rough type only. The stone is quarried in large amount for road making and for other purposes which require a hard and tough stone, but little is now used for building purposes except in the form of rubble for rough walls. The stone has a remarkably high crushing strength but it is seriously impaired by soaking in water.

Literature: Geol. Sur. Can., Report 1887-88 p. 24 K.
Geol. Sur. Can., Report 1888-89 p. 129 K.
Geol. Sur. Can., Report 1890-91, Part L.

GRENVILLE AREA.

The Chazy limestones exposed near Grenville have been utilized in a desultory fashion for local construction but I was unable to learn of any regular quarry now in operation. The exposures show hard and soft limestone, much banded and alternating with layers of shale. Buildings of this stone present a rough appearance with very distinct differential weathering bands. Grenville limestone was quarried on lot 7, range II, Grenville, for the construction of locks on the Ottawa river canals.[1]

[1] Geol. Sur. Can., Report 1888-89, p. 126 K.

The stone: No. 625. This is a hard, dark coloured limestone presenting about the shade shown in Plate [illegible]I, No. 1. Some beds are extremely fine grained with scattered glistening crystals of calcite. Other parts are coarser in grain and contain great numbers of fossils. The stone is rough and lacks uniformity which results in a serious deterioration on weathering.

[illegible] AREA.

The Trenton limestone [illegible] now being worked for the production of building stone as well as [illegible] purposes lie to the west of the city between Chaudière and L[illegible], on both sides of Brewery creek. Large quarries lie farther nor[illegible] but they are not operated for the production of building stone. The more [illegible] operators are as follows:

Wright and Co., Hull, Q[illegible]
Wright and Co., per [illegible]
M. Lefebre.
David Laviolette.
Fleming Dupuis Supply C[illegible].
Joseph Leduc.
Canada Cement Company.

Wright and Company, Hull, Quebec.

First quarry. This excavation is about 800 feet by 400 feet and extends over the four blocks bounded by Regent and Ann streets and by Autumn street and Brewery creek. A large part of the available stone has already been removed. The section exposed at the northeast corner of the quarry is as follows:

10-12 ft. Heavy boulder clay overburden.
2 ft. Thin material of dark colour.
1 ft.—Grey limestone of crystalline texture.
2 ft.—Dark limestone, coarse, thin bedded in places.
1 ft. Grey limestone.
2 ft. Grey limestone in variable beds.
20 in. Solid bed of good grey limestone (631).
1 ft. Thin shaly material.
10 in.
8 in. } Rather coarse grained grey limestone with fossils and dark bands.
6 in. } This stone is of building grade.
6 in. Shaly parting.
15 in.—Grey limestone, banded.
8 ft. Fine grained, greyish brown limestone in beds which vary greatly in thickness and are very differently bedded in different parts of the quarry. The stone is mostly thick however and would average a foot. It parts easily to any thickness desired (632).
4-5 ft.—Similar stone in thinner beds with more pronounced banding.

In certain parts of the property a heavy upper bed is encountered above this section. Stone from 15 to 24 inches thick has been cut from this layer. At the west side of the property the section is much less extensive as only about 8 feet of the lower beds are exposed. The strata dip N. 20° E., at about 3°.

Second quarry. The property lying west of Brewery creek and east of Lizzie street and extending 1,350 feet north of Walker street is controlled by this company with the exception of a section in the southwest corner belonging to the Laurentian Stone Co. A large quarry has been opened over several acres. The section is as follows:

2 ft. Stripping, soil and thin rock.

5 ft. Brownish limestone like 634, shattered and in variable beds.

4 ft. Brownish limestone, mostly solid, but in places divided into thinner beds (634).

4 ft. Thin shaly material. Removed in a few pits only.

2 ft. Variable bed resembling 634 but mixed with a greyish crystalline type. Some heavy stones for bridge piers have been cut from this layer.

The jointing is very irregular, with the most pronounced series of fractures striking W. 20° N.

Northward, to the limit of the property, small quarries have been opened at various places, showing 10 to 15 feet of thin material with a heavier brown bed at the bottom. As the dip observed east of the creek is not seen here, it is likely that these beds are at a lower level. Nearly all the product of these quarries is crushed.

Third quarry. This property is situated on Wall street a short distance north of Autumn street and extends about half way to Woburn street. It is on the property of Dr. Graham, but the quarrying rights belong to the Wright Company and the operations are conducted by Mr. Joseph Leduc. The stone has been removed over the greater extent of the property. The section is as follows:

4 ft. Thin shaly material.

9 in. Dark blue bed.

20 in. Dark blue stone.

Shaly parting.

8 in. Dark blue stone (628).

14 in. Dark blue stone.

16 in. Dark blue stone.

16 in. Dark blue stone.

12 in. Thin shaly material.

4 ft. Lighter limestone, building beds (629).

The joints run S. 20°W. and dip 70° to the westward. A second set crosses at right angles vertically. Large stone has been cut from the lower beds. At the time of my visit Mr. Leduc was cutting for the Notre Dame school in Hull. A derrick is installed. Two men are employed.

The stone: No. 629. A medium grained, semi-crystalline limestone of greyish colour with a slight cast of brown (Plate L, No. 7). It is much finer in grain than the Grande Ligne stones and finer than the average of the Montreal stones. It presents much the same grain as the St. Marc stone but, if anything, it is a little finer. The rubbed surface is bluish when dry but brown when wet and shows the fossil fragments disposed in layers. The etched specimen shows the fossils as white lines and dots with the more crystalline portions of a brownish tint. The general effect is greyish with white lines and small dark brownish spots.

The physical properties are:

Specific gravity	2.71
Weight per cubic foot, lbs.	167.742
Pore space, per cent	0.847
Ratio of absorption, per cent, one hour	0.191
“ “ “ two hours	0.223
“ “ “ slow immersion	0.273
“ “ “ in vacuo	0.288
“ “ “ under pressure	0.315
Coefficient of saturation, one hour	.697
“ “ “ two hours	.708
“ “ “ slow immersion	.817
“ “ “ in vacuo	.914
Crushing strength, lbs. per sq. in., dry	20,580.
“ “ “ “ wet	17,060.
“ “ “ “ wet after freezing	17,730.
Transverse strength, lbs. per sq. in	2,588.
Shearing strength, lbs. per sq. in	1,895.
Loss on corrosion, grams per sq. in	0.02785
Drilling factor, mm	11.9
Chiselling factor, grams	7.2

Analysis by Leverin: -

	per cent.	
Insoluble matter	0.56	
Ferric oxide and alumina	0.96	
Calcium oxide	53.85	equivalent to 96.16 per cent carbonate of lime.
Magnesium oxide	0.52	equivalent to 1.08 per cent carbonate of magnesia.

No. 628. This bed shows two types of stone, a hard fine grained non-crystalline type and a coarse grained semi-crystalline variety. The two types are interbanded and fragments of the fine grained component are included in the crystalline portion. The stone is rough and not suited to fine work.

No. 631.– A greyish, uniform, semi-crystalline limestone closely resembling No. 629 described above.

No. 632.– This is a fine grained, uniform, semi-crystalline limestone similar to No. 529 but of somewhat finer grain. The colour is lighter however, and a rather pronounced banding is apparent in the presence of fine blackish lines parallel to the bedding.

No. 634.–Closely resembles No. 632. Differs in being of a darker colour and slightly finer grain. The banding effect is sharper with the blackish lines closer together. It closely resembles No. 633 (Plate L. No. 16) but is of lighter colour.

The following analyses of stone from Wright's quarry are taken from the Report of the Geological Survey of Canada, Part G, p. 45, 1899.

	I	II	III	IV
Carbonate of lime	97.66	96.25	96.19	96.92
Carbonate of magnesia	1.38	2.18	1.72	1.59
Carbonate of iron	0.16	0.32	0.26	0.25
Alumina, soluble silica and insoluble matter	0.67	1.33	1.74	2.06
	99.87	100.08	99.91	100.82

No. I– Uppermost bed, two feet.
No. II Third bed, one foot three inches.
No. III Fifth bed, one foot two inches.
No. IV Tenth bed, one foot six inches.

The normal school in Hull was built of this stone in 1908. The rock face work shows a uniform, pleasing, greyish tint, and the hammered work a very light grey. Wavy bedding planes are to be seen in a few blocks only, but there is very little sign of plucking as the stone dresses excellently to a smooth surface.

In all, Wright and Co. employ about 30 quarrymen and 40 labourers in connexion with the crushing plant, etc.

Rubble is quoted at $1 per ton delivered, and rough building blocks at 50 cents per cubic foot delivered in Hull.

The crushing plant consists of an Austin No. 5 and a Gates No. 3 with a total capacity of 600 tons a day.

A. Morin, Hull, Que.

The quarry worked by Mr. Morin lies between Leduc's quarry and Woburn street on the property of Mrs. Wright. The succession of beds follows down from that exposed in Leduc's quarry as follows:

6 ft. Brownish stone much banded, in beds up to 14 inches (630). This bed is worked as an upper bench

20 ft. Mixed brown and grey stone, mostly brown-banded like No. 630, in beds up to 16 inches. This is worked along a face of about 200 feet as a lower bench.

The beds dip northwest at a low angle. The product is all made into rubble or crushed stone. Four or five men are employed.

The stone: No. 630. A fine grained semi-crystalline limestone almost identical with No. 632 described under Wright's quarry on page 101.

M. Lefebre, Hull, Que.

M. Lefebre works the small piece of property lying between Leduc's quarry and Autumn street. He is cutting stone from the building bed described as No. 629 in Leduc's quarry.

Four cutters are employed.

David Laviolette, Hull, Que.

This quarry property lies between Regent and McKay streets north of Wright's quarry described as the "First quarry." The bed being worked is that which lies above the general section given for Wright's quarry and which is only occasionally present on that property. The bed here is from 1 to 5 feet thick in layers up to 18 inches: it is covered by 8 to 12 feet of boulders and earth.

The stone: No. 633.—This example is shown in Plate L, No. 16. It belongs to the class of fine grained, semi-crystalline stones of which Nos. 632 and 634 have already served as examples. Omitting the types of stone which are practically non-crystalline such as the Beauport, St. Dominique, and the black Montreal stones, the present example has the finest grain of any of the better known Quebec building stones of the semi-crystalline class. This stone is darker than either No. 632 or 634 and like them shows fine black lines along the planes of bedding.

The rubbed surface is bluish and the etched surface is grey. Owing to the very fine grain, the latter presents a uniform appearance at a little distance. Close inspection, however, shows a fine "pepper and salt" effect, the lighter portions being fossil fragments and the darker calcite crystals.

The physical properties are as follows:

Specific gravity (average)	2.714
Weight per cubic foot, lbs.	168.519
Pore space, per cent	0.4975
Ratio of absorption, per cent, one hour	0.0995
" " " " " two hours	0.133
" " " " " slow immersion	0.1847
" " " " " in vacuo	0.1847
" " " " " under pressure	0.1847

Coefficient of saturation, one hour	.538
" " " two hours	.721
" " " slow immersion	1.00
" " " in vacuo	1.00
Crushing strength, lbs. per sq. in., dry	25,100
" " " " " " wet	22,150.
" " " " " " wet after freezing	19,600.
Transverse strength, lbs. per sq. in.	3,273.
Shearing strength, lbs. per sq. in.	1,770.
Loss on corrosion, grams per sq. in.	0.03345
Drilling factor, mm.	13.2
Chiselling factor, grams	9.6

Analysis by Leverin:

	per cent.
Insoluble matter	0.60
Ferric oxide and alemina	1.16
Calcium oxide	53.65 equivalent to 95.80 per cent carbonate of lime.
Magnesium oxide	0.74 equivalent to 1.54 per cent carbonate of magnesia.

Mr. Laviolette has a hand derrick and employs 2 quarrymen, 3 cutters and 2 drivers. The production averages 30 cubic ft. per day the year round. The following prices are quoted:

Rough blocks, 50 cents per cu. ft., delivered.
Sills, rock face, bushed tops, 65 cents per ft., delivered.
Cellar window jambs, 75 cents each, delivered.

As the total product of this quarry is used for building purposes the stone has been described in detail above.

Joseph Leduc, Hull, Que.

This quarry, which is not now in operation, lies on the river front in Wright's bay, farther east than those already described. The property is surrounded by buildings and only a limited amount of stone is available. The present quarry extends into a small property adjoining this to the north.

The succession of beds, of which the upper ones are largely removed, is as follows:

15 in.—Shattered stone.
1 ft.—Hard, thin bedded stone.
2 ft. 6 in.—Good grey bed.
Shaly parting.
15 in.—Greyish bed of crystalline character but coarse grained and banded.

10 in. Shale and thin limestone.

2 ft. Coarsely crystalline limestone with shaly band in the middle.

8 in. Thin and shaly stone.

10 in. Good grey bed.

3-4 ft. Fine grained greyish fossiliferous limestone with crystalline structure. In places it parts to thinner material but on the whole is an excellent building bed (637).

3-4 ft. Grey limestone like bed above but it is more banded and is not quite so desirable a stone. In places it parts into thinner layers (638).

The beds strike northwest and dip southwest at 10° which would carry the desirable stone to greater depths on the adjoining property to the west. The main joints strike N. 35° W., vertically. Cross joints are not frequent. Very large blocks are easily obtained.

The stone: No. 637.—This is a semi-crystalline, fossiliferous limestone of coarser grain and lighter colour than the two specimens, Nos. 629 and 633, which have been described in detail. It is about the colour of No. 632 and presents a grain comparable with that of Plate E, No. 6. This stone has a reputation for preserving its colour under the action of the weather.

No. 638.—This specimen resembles No. 632, but it is a rather better stone in that the fine dark lines parallel to the bedding are less pronounced.

Fleming Dupuis Supply Co., Ottawa, Ont.

This property lies north of Wright's second quarry but on the opposite or east side of Brewery creek. The quarry is about 400 feet by 200 feet and extends to a depth far below the level of the stream. The following sequence is presented:

10 ft.—Thin bedded brown and grey fossiliferous limestone with a somewhat heavier bed at the bottom.

Very distinct parting.

15 ft. Laminated brown limestone, mostly parting thin but with some heavier beds in places which are possible for coursing stone. This bed is said to make the best crushed stone (636).

15 ft.—Thin bedded dark coloured limestones of no use as building material.

The stone: No. 636.—This example very closely resembles Nos. 632, 634, and 638. It is probably most closely comparable with No. 638, above.

The product of this quarry is all crushed. Thirty-five men are employed. Two derricks and a crusher of 300 tons capacity are operated by electric power. One drill on steam power.

Canada Cement Company, Hull, Que.

This quarry is on the west side of the creek to the northward of that of the Fleming Dupuis Co. The opening is nearly quarter of a mile long, 300 feet wide and 90 feet deep. About 500 tons a day are quarried for cement making during eleven months of the year.

Four types of stone are revealed in descending order as below:

10 ft.—Thin bedded brown and grey limestone as in the Fleming Dupuis quarry (A).

20 ft.—Brownish banded limestone of which some layers are suitable for building (B).

55 ft.—Thin bedded darker coloured stone (C).

4 ft.—Cherty layers (D).

I am indebted to Mr. A. G. Fleming, the chemist of the company, for analyses of these four types of stone which are reproduced below:

	A 1	A 2	B 1	B 2	C	D
Silica	4.30	4.16	1.97	3.06	2.98	7.90
Ferric oxide and alumina	1.00	1.46	0.11 0.81	0.60	0.90	1.78
Calcium oxide	51.45	51.74	54.20	53.47	51.56	49.26
Magnesium oxide	1.15	0.90	0.56	0.59	2.01	0.60
Loss on ignition	41.50	41.50	42.92	42.22	42.34	40.36

Summary—Hull Area.

Limestones of the Trenton formation have been extensively quarried at Hull for building stone, for macadam and concrete and for the making of Portland cement. The formation is thick but the types of stone suitable for structural purposes are interbedded with less valuable material. The most desirable stone seems to occur towards the top of the series as here represented. The average building stone is a rather fine grained, semi-crystalline limestone with a much finer structure than the Montreal limestone or the well known Deschambault or St. Marc stone. Hull stone varies in the fineness of grain and in the degree to which fine black parting lines are developed on the planes of stratification. The stone ranks among the best produced in the province. Two typical examples are described on pages 100 and 102.

Literature: Geol. Sur. Can., Report 1899, pp. 24, 25, 45 G; p. 88 J.
Geol. Sur. Can., Report 1890–91 p. 183 S.

ROBERVAL AREA.

Simon Simon, Roberval.

A small quarry in the local limestone has been operated at intervals for the production of stone for lime burning and for use in foundations.

The stone occurs in level beds from 10 to 18 inches in thickness; when fresh, it has a dark blue colour but it rapidly weathers light and assumes a clay-like appearance. Limestones are exposed at many points along the shore of Lake St. John but their suitability to purposes of construction has not been determined.

MALBAIE AREA.

Limestones of Trenton age have been quarried to a very limited extent from the cliffs below Murray bay. As this area is better known on account of the associated sandstones, the limestones are described with the sandstones on pages 128-132.

Limestones of the Beekmantown Formation.

The Beekmantown formation, formerly known as the *Calciferous*, consists largely of brownish dolomitic limestones frequently with an admixture of sand. The stone is usually of a rough character and subject to rapid weathering whereby a dirty, dull and streaked appearance is produced. Nevertheless some stone of good quality has been raised from the formation in the province of Ontario, more particularly in the townships of Augusta and Beckwith. In Quebec the exposures of Beekmantown stone are less satisfactory and have yielded only rough building material and sandy layers suitable for flagging. The following quotation indicates the nature of the stone and its general distribution in Quebec.

"The rock itself varies somewhat in character, but usually is a greyish semi-crystalline dolomite or magnesian limestone, which is generally arenaceous or siliceous and occasionally argillaceous. In many instances it holds geodes of quartz and calcite, and irregular streaks and patches of black chert.

"In horizontal distribution it succeeds the Potsdam formation forming a second belt along the margin of the old continent, and is well developed in the counties of Terrebonne, Two Mountains, and on the northwest side of Ile Jesus, the west end of Ile Bizard and the Island of Montreal, and south of Lake St. Louis and in the county of Beauharnois. From surface measurements the thickness of the formation seems to vary from 300 to 450 feet."[1]

The quarries in this formation in the province of Quebec are insignificant. Two localities were visited and are described below as representing two distinct geographic areas.

The Beekmantown formation occurs south of Lake St. Louis in two wide areas, of which the western covers most of the county of Beauharnois and the eastern extends from the river front of the seigniory of Chateauguay to the international boundary. Despite its wide extent the formation in this region has been very little quarried. The only quarry of any importance is that described below. A quarry was also worked at the mouth of River Delisle for the construction of the Soulanges canal.

[1] Geol. Sur. Can., Report 1901, p. 29 O.

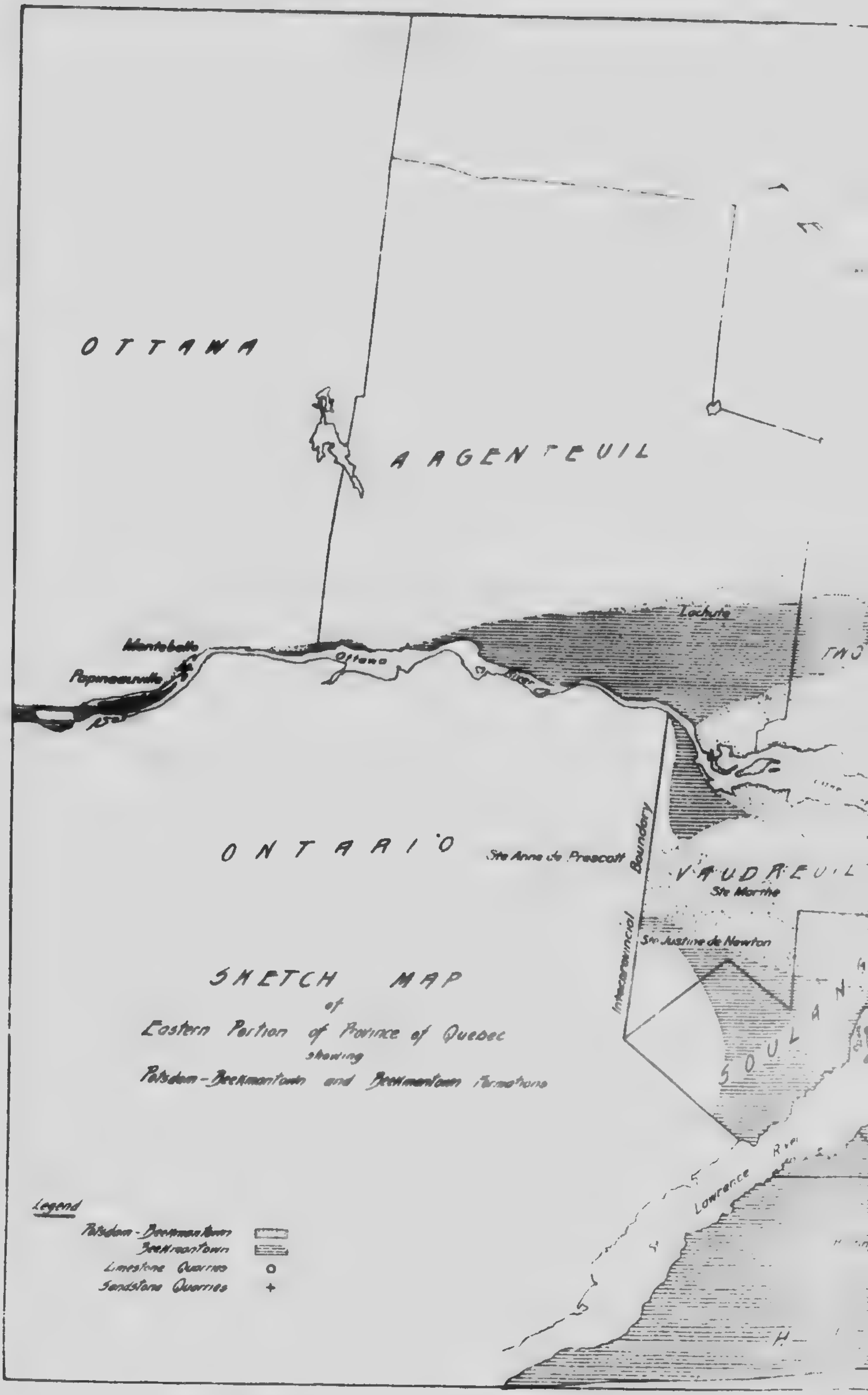
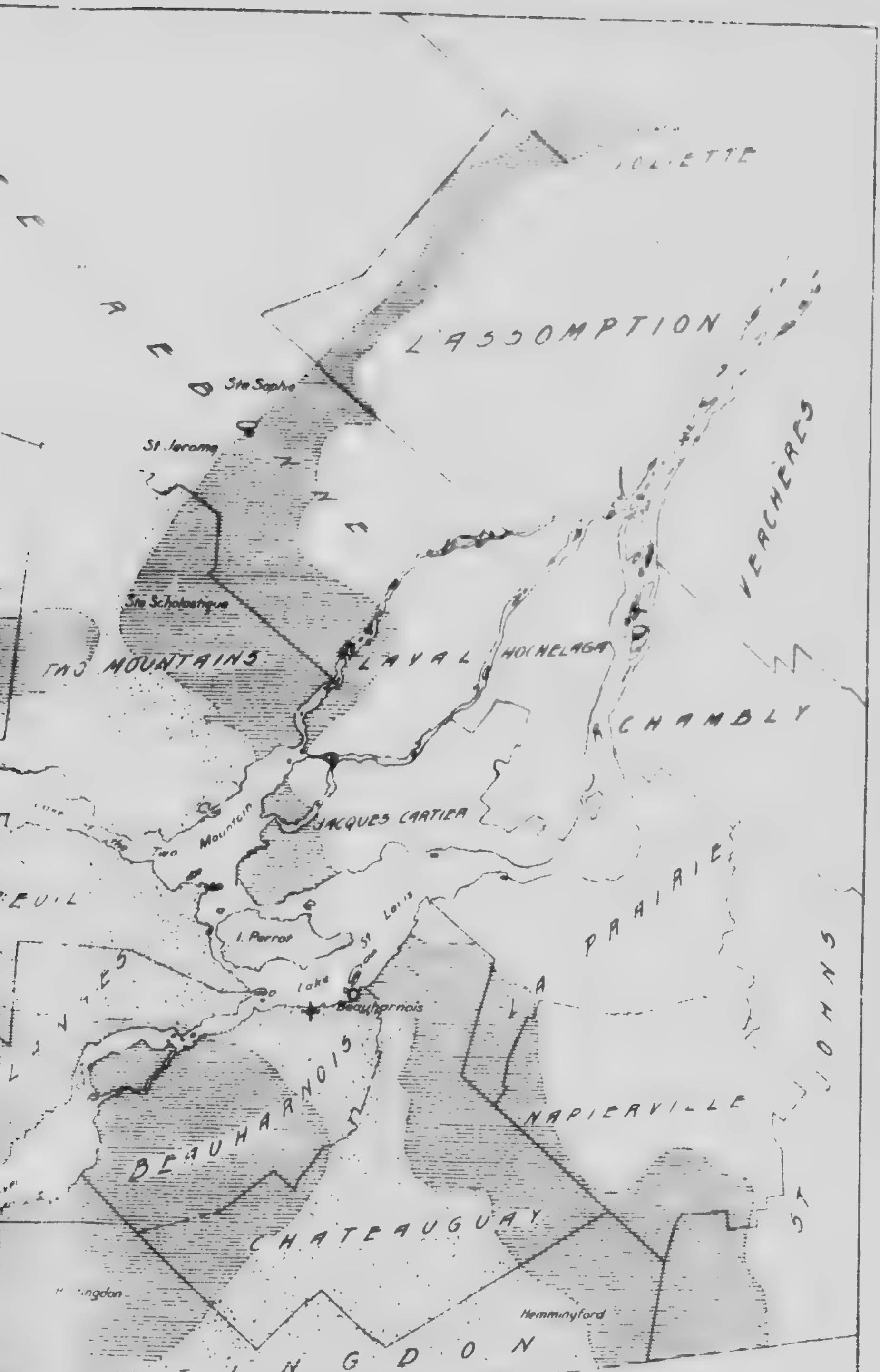


Fig. 4 Sketch map showing the distribution of the Potsdam-Beekmantown sa



antown sandstone and the Beekmantown formation, with the chief quarries.

Trenton sandstone. Cliffs at Murray Bay, Que

BEAUHARNOIS AREA.

Francois Albert, Beauharnois, Que

Near the river front on the point about two miles east of Beauharnoi a small quarry is worked for foundation stone on the property of Mr. Albert The overburden is light, permitting the opening of small pits at a number of points. The beds are about 18 inches thick and in places are full of fossils.

The stone: No. 611. This is a hard massive, steel-grey stone of about the grain shown in Plate L, No. 16. The colour more closely resembles that of No. 15 in the same plate. The fresh fracture shows minute glistening facets. This is a very impure stone as it contains a large amount of quartz in minute bluish grains. The weathering properties are poor as it rapidly assumes a dirty brownish yellow colour. It would be very hard to chisel.

An analysis of this stone proves that it is highly magnesian in character as below:

	per cent	
Insoluble matter............	5.10	
Ferric oxide and alumina.....	6.36	
Calcium oxide..............	29.35	equivalent to 52.41 per cent carbonate of lime
Magnesium oxide...........	15.96	equivalent to 33.40 per cent carbonate of magnesia.

No. 612. This stone is similar in grain to No. 611 but its colour is brown rather than steel-grey. It contains less quartz but is filled with large white fossil shells (Ophileta). In buildings both these stones present a dirty brown colour, with a streaked and pitted appearance after weathering: they cannot be regarded as desirable material.

ST. JEROME AREA.

The Beekmantown formation occupies a wide area in Two Mountains and Terrebonne and stretches thence as a narrow belt along the flank of the old Pre-Cambrian highlands, to the seigniory of Cap de la Magdelaine north of Three Rivers. The literature contains very little reference to the use of the stone as a building material and I have been unable to learn of any actual working quarry throughout the whole extent of the belt. Nevertheless the stone is quarried from small pits at a number of places of which the following may be considered typical for the vicinity of St. Jerome. At other localities along the belt the stone is of a browner colour and is more magnesian in character.

On the road between St. Jerome and Ste. Sophie in the township of Terrebonne limestones of the Beekmantown formation are exposed at a point about 4 miles from St. Jerome and 3 miles from Ste. Sophie. The exposures extend over several properties of which the one described below is typical.

Mme. Antoine Daourin, Ste. Sophie, Que.

On this property and on those adjoining the stone is either exposed or occurs under a slight stripping. The upper beds have been quarried in layers of 8, 12 and 14 inches. The beds dip at a low angle S. 10°E. and are cut by distinct joints, S. 40°E. at intervals varying from 2 to 8 feet. The stone is practically the same in all three beds and is described below as No. 614.

The stone: No. 614.– When fresh this example presents a clean even dark grey colour; it is rather hard and finely granular or crystalline in structure and to all appearances is a quite desirable material. Unfortunately however it is unable to withstand the action of the weather as it very rapidly assumes a dirty yellowish colour accompanied by a softening which extends deep into the stone. This result is probably due to an argillaceous content in which unoxidised iron is present in some abundance.

The stone has been used locally for building and for paving flags. When exposed for some time it presents a brown and dirty appearance with distinct etching along the planes of stratification.

The Beekmantown formation also occurs over a wide area in Vaudreuil and extends thence along the Ottawa river where it is exposed at intervals. The most westerly outcrop mapped is near the mouth of the Quio river where a small quarry was worked on passage beds between the Beekmantown and the Potsdam. A dark brown stone of rough appearance strongly resembling the poorer type of Beekmantown stone as obtained at Prescott and Brockville in Ontario is used in buildings in Portage du Fort, Shawville, and other places in the county of Pontiac.

Walter Bennett, Portage du Fort, Que.

The brownish limestone mentioned above has been quarried on this property which is situated about half a mile from the village of Portage du Fort. The upper beds are thin, ranging from 3 to 6 inches in thickness, but at a depth of 15 to 20 feet, beds as much as 4 feet thick are encountered.

The same stone is found on the adjoining properties of Wm. Hodgins, H. Kallies, and J. McLean. The strata are level and not excessively jointed but the amount of work that has been done is not great.

The stone: A brownish semi-crystalline dolomitic limestone, with inclusions of calcite crystals in places. The stone weathers rather badly, and becomes yellowish and lacks uniformity. It appears to be Beekmantown stone but as no fossils were seen and as no outcrop of this formation is mapped in the vicinity the age of the stone can not be stated with certainty.

Limestones of the Silurian System.

Silurian limestones which have not yet been satisfactorily ascribed to formations are quarried at several widely separated points in the province. The most important of these is the group of flagstone quarries in the township of Dudswell in Wolfe county: of less importance are the limestones of Millstream and Sayabec on the line of the Intercolonial railway in Gaspé and those of Port Daniel on the north shore of the Baie des Chaleurs.

DUDSWELL AREA.

The region north of Dudswell and Bishops Crossing, particularly along the fifth range of Dudswell, has produced a large amount of excellent flagstone from a dark bluish limestone which occurs in thin and remarkably even beds. The occurrence of these beds was referred to by Sir Wm. Logan as follows: "To the east of the Quebec road in the sixth range of Dudswell, there is an aggregation of thin layers among the limestone strata, which would yield very excellent calcareous flagging; the colour is grey, the rock highly crystalline and capable of a polish, and being naturally divided into plates of two to three inches thick, it is resorted to for grave stones, and in consequence goes in the neighbourhood by the appellation of the 'tombstone bed.' "[1]

Ells in 1886 refers to these deposits in the following words: "Flagging stone of very fine quality is also found near by in lot 15, range V, Dudswell. Four quarries are now in operation, owned principally by Bentley and Sons, and Henry Sunbury. The rock, which dips southeasterly at an angle of 20 to 30 degrees, is a bluish dark limestone, in regular beds, ranging in thickness from one to eight inches, with dark shaly partings. Stones of almost any required size can be taken out."[2]

It is estimated that about 100 acres of good flagging has been proved in the district. The desirable areas are not continuous but occur here and there with much broken and undesirable material between. In consequence, small operations have been carried on at a number of places. At the time of my visit only one quarry was actually being worked but another had recently been abandoned. The former of these belongs to Wm. Bentley and the latter to Albert Westman and both are situated in the fifth range of Dudswell.

Wm. Bentley, Bishops Crossing, Que.

The formation strikes N. 10°E. and dips 22° to the southeast (E. 10°S.) The bedding is remarkably even in layers from 2 to 10 inches thick. Very clean joints strike exactly with the formation and dip 50° to the westward (W. 10 N.): these joints vary from 2 to 30 feet apart but average about 6 feet and cut the rock into excellent strips. The cross joints strike E. 30°N. and are infrequent. Occasional irregular cracks cross diagonally but in the quarries they are usually very widely spaced. It is the multiplication of these irregular fractures that renders the stone useless over considerable areas.

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[1] Geol. Sur. Can., Report 1847-48, p. 83.

[2] Geol. Sur. Can., Report 1886, p. 69 J.

The remarkably even bedding and clean jointing make the quarrying of flags very easy. The thicker beds are easily split to a desirable size in the case of the stone from near the surface, but this ability to cleave decreases with depth. Along the strike, continuous strips were observed having a length of 128 feet. Slabs 11 feet by 12 feet and 7 inches thick have been shipped.

The overburden varies greatly: in the present quarry, which is about 3 acres in extent, it consists of 3 to 7 feet of hard pan.

The stone: No. 759.—This is a dark grey, very fine grained stone with a distinctly laminated structure. The laminæ show different colours, varying from a prevailing, almost black type to thin layers which are almost white. After etching, the differences in colour are more pronounced and the stone is seen to be composed of three elements, a preponderating steel-grey component, an almost white component in fine layers, and a black clayey or bituminous component which occurs in very fine lines. On the whole, this stone stands the weather very well; it does not assume a dirty colour but shows merely an intensification of the contrast in the three components.

The physical properties are as follows:—

Specific gravity	2.709
Weight per cubic foot, lbs.	167.411
Pore space, per cent.	1.0006
Ratio of absorption, per cent, one hour	0.1988
" " " " " two hours	0.2168
" " " " " slow immersion	0.333
" " " " " in vacuo	0.3535
" " " " " under pressure	0.3755
Coefficient of saturation, one hour	.53
" " " two hours	.57
" " " slow immersion	.88
" " " in vacuo	.94
Crushing strength, lbs. per sq. in., dry	29,200.
" " " " " " wet	33,500.
Loss on corrosion, grams per sq. in.	0.01909

Mr. Bentley has installed a windmill for pumping, a derrick operated by a gasoline engine for lifting the stone, and three hand derricks of three tons capacity each. Five men are employed. It was expected that about 200 tons of flags would be shipped in 1912. Flags from 2 to 5 inches thick are

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[1] Great difficulty was experienced in obtaining duplicate results with this stone. The figures given are evidently anomalous. The cause of difficulty lies in the variable nature of the stone particularly in the development of the black component.

valued at $1 per square yard, f.o.b. The product is now used chiefly in Sherbrooke, St. Hyacinthe, and East Angus for flagging. The use of the material for building is now restricted to local foundations, etc. Walls which were constructed of this stone many years ago prove the durability of the material and that its resistance to changes in colour is of a high order.

Albert Westman, Bishops Crossing, Que.

The quarry on this property is small and is not now in operation although a serviceable derrick is still in position. Most of the good stone seems to have been removed. It is interesting to note that the strike and dip of the formation at this point are quite differeat from the position indicated above for Bentley's quarry which is only a quarter of a mile distant. The strike is N. 50° E. and the dip 30° to the southeast. Here also the most pronounced set of joints strikes southeast and dips 45° to the northeast.

The stone: No. 758.—Practically identical with No. 759 described above.

MILLSTREAM AREA.

Along the Intercolonial railway north of Millstream are several outcrops of limestone. The formation strikes southeast and dips 20° to northwest at the point where the quarry was opened about half a mile north of Millstream. Several exposures were observed farther north but the stone is thin and presents a greater angle of dip.

The quarry is about 100 feet by 50 feet with a face of 20 feet. The beds are thick, up to 4 feet, but all the stone is strongly laminated, with a tendency to part along the stratification planes into thinner material. Very perfect joints cross the formation in a north and south direction at intervals of 2 to 6 feet. These joints being straight, vertical and well defined, materially assist quarrying operations. There is no doubt that heavy stone could be obtained in quantity with a small amount of waste. Exposed surfaces show ferruginous weathering, and an intensification of the banded structure. As observed in bridges, the stone as a whole weathers much lighter and not uniform, as certain of the bands become dark and soft with a consequent etching out under the action of the weather.

The stone: No. 825.—A very fine grained stone composed of two elements—a fine grained crystalline component of dark grey colour and a still darker non-crystalline, clayey variety. The two types are intimately interbanded (Plate LI, No. 3). Corrosion produces very little change—less than in any true limestone tested for this report. It is significant also that this is the only stone of this class which shows a gain in weight on corrosion. Despite this test it is certainly true that long continued exposure to the weather produces marked changes in the stone as mentioned above.

The physical tests resulted as below:—

Specific gravity	2.737
Weight per cubic foot, lbs.	168.902
Pore space, per cent	1.088

Ratio of absorption, per cent, one hour	0.1075
" " " " " two hours	0.131
" " " " " slow immersion	0.2925
" " " " " in vacuo	0.351
" " " " " under pressure	0.401
Coefficient of saturation, one hour	.26
" " " two hours	.32
" " " slow immersion	.73
" " " in vacuo	.87
Crushing strength, lbs. per sq. in. dry	20,280.
" " " " " " wet	13,210.
" " " " " " wet after freezing	10,220.
Transverse strength, lbs. per sq. in.	4,684.
Shearing strength, lbs. per sq. in.	4,555.
Gain on corrosion, grams per sq. in.	0.00326
Drilling factor, mm.	7.8
Chiselling factor, grams	2.

It should be observed that this stone shows a rather unusual set of physical properties. The almost imperceptible effect of corrosion and the gain in weight are unique among the Quebec limestones. The very high transverse and shearing strengths without a commensurate gain in crushing strength is remarkable. The pronounced loss in strength in soaking is common in highly argillaceous limestones and was observed also in the Beauport stone. The very low chiselling factor shows that the stone would be difficult to work.

An analysis by Leverin gave the following results:

	per cent.
Silica	59.50
Ferric oxide and alumina	22.60
Calcium oxide	4.55
Magnesium oxide	3.29
Combined water	4.14
Carbonic acid and undetermined matter (by difference)	5.92

This analysis shows the stone to be a calcareous shale rather than a limestone and explains the peculiar physical properties to which attention has already been drawn.

Sayabec.

Silurian limestone is quarried near Cedar Hall, 1½ miles above Sayabec station on the Intercolonial railway. The stone is heavily bedded with layers up to 3 feet in thickness. All the product of the quarry shows pronounced wavy brownish lines parallel to the bedding. These lines are sometimes as much as ¼ inch in thickness and are spaced about one inch apart. On weathering the stone becomes much lighter with the above mentioned bands softer and more brownish.

The stone: No. 827.—A dark coloured, fine grained, hard and splintery limestone: it is lighter in colour and a little coarser in grain than the Millstream stone described as No. 825. Unlike the Millstream stone, it is fairly uniform in structure and does not show the intimate black banding characteristic of that stone.

This stone has been used for the church in Causapscal and in the Intercolonial railway bridge at the same place. In the church the stone is laid up in 10 to 12 inch coursing which presents a dark appearance with disfiguring films in places. The stone is hard to dress but it receives a fair point finish. The bridge, which is older, shows that the stone turns much lighter under the influence of the weather.

Z. Chabot, Causapscal, Que.

M. Chabot quarries a hard dark coloured and thin bedded stone at a point 1½ miles north of Causapscal. This material is employed for foundations only.

Limestone is exposed in the railway cut near Matapedia and has been employed locally to a limited extent (824).

The stone: No. 824. This is a fine grained stone intermediate between a slate and a limestone; it would be better described as a calcareous slate. Layers of true slate are mixed with the calcareous layers and the whole complex is so contorted that the stone breaks with great irregularity along the slaty layers. It is also cut by numerous veinlets of white calcite. No value.

PORT DANIEL AREA.

A.D. Le Grand, Port Daniel, Que.
Edgar Lawrence, Port Daniel, Que.

About one and a half miles west of the wharf at Port Daniel the eastern edge of a limestone formation is encountered which extends 6 miles west along the shore and reaches inland a distance of 2 miles. A small amount of stone has been quarried here for local use.

On the property of Mr. Le Grand, the formation strikes E. 40°S. and dips 18° southwest. A strong set of joints runs with the strike at intervals of 6 to 8 feet. A second set strikes E. 20°N. The upper bed at the quarry is 14 inches thick with a level but uneven floor due to the presence of numerous silicified fossils on the bedding planes (813).

Higher up on the hillside the stone is excessively fractured by the action of frost and appears to be very cherty and rough.

The stone: No. 813.—An exceedingly fine grained stone very closely resembling the Beauport stone described as No. 574 on page 96 (Plate LI, No. 1). It is very hard and splintery and contains scattered cherty concretions. Weathered pieces show a dirty yellowish brown colour but the alteration is superficial only.

Limestones of the Niagara Formation.

LAKE TIMISKAMING AREA.

Building stone has been quarried on the east side of Burnt island in Lake Timiskaming at a point about half a mile below the north end of the island. Stone suitable for lime burning is obtained here and has been burned in a small kiln on the island. The section exposes about 50 feet of stone of which the upper 20 feet is thin bedded limestone of no value as a building material. The lower 30 feet show beds of increasing thickness and with a greater content of sand towards the bottom. These strata probably represent a transition to the sandstones of the east shore.

Building stone is quarried at the water level to the southeast of the section described above. The quarries extend along the shore but are of limited extent inland as the overburden rapidly increases. The lower 7 feet show the stone in level beds up to 14 inches in thickness. The overlying material is thin but it would probably increase in thickness inland, as the tendency to part on the bedding planes is much increased by the action of the weather. The jointing is rectangular and rather too close for the production of large stone but material of sufficient size for ordinary coursing is easily obtained.

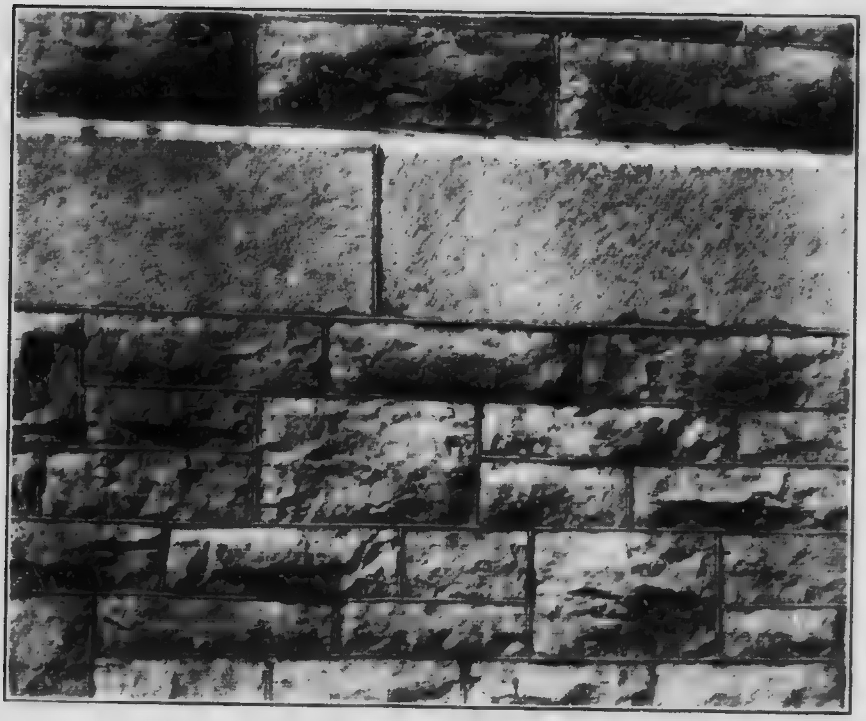
The stone: No. 938.—This stone is a fine grained, yellowish-brown dolomite with a considerable content of sand: it is shown in Plate LI, No. 13. The stone is more dolomitic and less sandy than the so-called sandstones from Piché point on the east side of Lake Timiskaming which are described as Nos. 937 and 939 on pages 133-134. The Burnt island stone represents the upper beds of the same series of deposits to which the Piché point strata belong.

A microscopic examination shows that the rock consists essentially of very fine crystals of dolomite which are about 0.1 mm. in diameter. The pore space is considerable and sharp angular grains of quartz somewhat larger than the dolomite crystals are scattered through this matrix. This stone should be capable of receiving fine chiselling and should not be difficult to work.

An analysis by Leverin resulted as follows:

	per cent.	
Insoluble matter	14.00	
Alumina	1.98	
Ferric oxide	0.51	
Ferrous oxide	0.29	
Calcium oxide	27.00	equivalent to 56.7 per cent carbonate of lime.
Magnesium oxide	15.90	equivalent to 33.39 per cent carbonate of magnesia.
Combined water	1.06	
Carbonic acid and undetermined matter by difference)	39.26	
Sulphur	none.	

PLATE XIV



Niagara sandstone. Wall of Presbyterian church, Haileybury, Ont.

Burnt island stone has been used to some extent in Haileybury for foundations and also as coursing stone in walls. The Church of England is built of this stone and is sufficient evidence as to its durability. The lack of uniformity in the weathering of different blocks is noticeable. The general effect is not pleasing as most of the stone has assumed a dirty, yellow-brown colour. It is probable that a longer period of weathering would improve the appearance as there is a tendency for the yellow colour to leach out on long continued exposure.

On the west side of Burnt island, a quarry was opened in the upper fine grained beds for the production of lithographic stone. These beds are here at the level of the water and present rather thin layers which part readily on the planes of stratification. The venture was not successful and the quarry has long been abandoned.

Impure Limestones of Doubtful Age.

Belmont Real Estate Co., Sherbrooke, Que.

Just east of the city limits this company holds 4 acres of land on which a stony ridge runs about 10 feet above the average level. The beds of limestone dip east at varying angles; they are much twisted and interlaminated with slaty material. Strong and numerous joints cross at a little north of west. The deposit has no possibilities except for the roughest type of construction.

The stone: No. 752.—This is a very hard, fine grained, light coloured stone of a true grey colour when freshly broken. On weathering it darkens rapidly and after a considerable exposure shows a dark brown and honeycombed surface. In spite of its fine grain the stone presents a granular surface owing to the presence of a large percentage of quartz grains; in this respect it resembles some of the Beekmantown stones.

Fraserville.

In the railway cut at Rivière du Loup, red and green shales are exposed striking southwest and dipping at high angles to the southeast (808, 809). In places are interbedded layers of limestone (812) which have no economic value.

The stone: No. 808.—A soft fissile light greenish slate of no value as a building material and too soft and shattered to serve as a source of roofing slate.

No. 809.—A soft red slate of undulating cleave. Much jointed and broken. No value.

No. 812.—A hard, compact, thin bedded slaty limestone closely resembling the Dudswell flagstone described as No. 759 on page 110.

CHAPTER IV

SANDSTONES OF THE PROVINCE OF QUEBEC.

Sand-stone of a quality suitable for structures of importance is of rare occurrence in the province of Quebec, but more or less desirable stone has been raised from no less than six different formations. The nature of the stone is quite distinct in these different formations and is briefly indicated below

Potsdam-Beekmantown.- This formation which is commonly called the *Potsdam* but which I prefer to indicate as above because it gradates upwards into undoubted Beekmantown, consists for the most part of hard white sandstone and is almost a quartzite in places. It is usually much disfigured with iron stains.

Sillery. This stone is very hard and compact, of a greenish colour usually but sometimes presenting other tints. It is a very solid and durable stone but it is too hard and rough for fine work.

Trenton. Coarse grained calcareous sandstones.

Niagara. Generally speaking this stone is very coarse in grain, friable, and subject to iron stains on weathering.

Devonian. The stone of this system, as exposed on the line of the Intercolonial railway in the peninsula of Gaspé is a fine grained, homogeneous, reddish sandstone and is by far the most desirable of the Quebec sandstones.

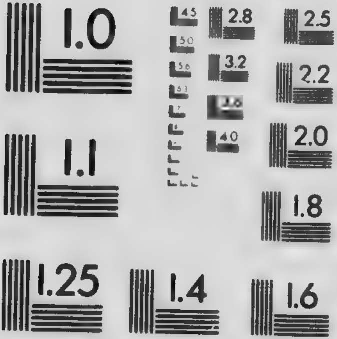
Carboniferous. Sandstone of this system occurs on the north side of the Restigouche river opposite Campbellton, N. B. It would be referred to the olive-green class of sandstones but it is a coarse and friable type not comparable with the better varieties of the Carboniferous sandstones of the Maritime provinces.

Sandstones of the Potsdam-Beekmantown Formation.

Sandstones of this formation represent the off-shore deposits of an advancing sea in Upper Cambrian and possibly also Lower Ordovician time. The formation is the oldest of the Palaeozoic series represented in the province and consequently it is found immediately on the flank of the ancient Pre-Cambrian crystalline axis. Its distribution is necessarily so complex that it would be out of place to attempt a description here. It might be said, however, that its greatest development is in Vaudreuil, Soulanges, Two Mountains, Beauharnois, Chateauguay, and Huntington, whence it extends as a narrow band eastward along the Pre-Cambrian axis to about the longitude of Three Rivers and westward with many interruptions to the mouth of the Quio river in the township of Onslow. It is obvious that a hard and durable sandstone exposed at numerous places has afforded many opportu-

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



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nities for quarrying of which advantage has been taken for purposes of local building, for making flags, for furnace linings and other minor applications. It is evident that only a few of the best known of the reported occurrences could be visited: if these may be regarded as typical there is little hope of this formation yielding stone of a grade suitable for other than rough building, nor was any seen comparable to the product of the same formation at Nepean and other points in Ontario.

The reports of the Geological Survey contain many references to the occurrence of these sandstones: the more important localities from the economic point of view are as follows:—

Argenteuil.

Rep. 1890-91, p. 37 AA *One quarter mile east of Lachute station.*
Rep. 1888-89, p. 125 K *Between Lachute and St. Jerome.*
Rep. 1863, p. 813 *Front of Augmentation of Grenville.*

Beauharnois.

Rep. 1863, p. 813—*Beauharnois village.*

Chateauguay.

Rep. 1863, p. 813—*Lot 151, Range II, Williamstown.*

Huntington.

Rep. 1863, p. 183—*Lot 80, Range II of Hemmingford.*
Rep. 1888-89, p. 125 K *Good beds at Hemmingford.*
Rep. 1894, p. 89 J *Between Huntington and Hemmingford.*

Joliette.

Rep. 1890-91, p. 40 AA *Brownish weathering coarse whitish grey stone on L'Assomption river above Joliette.*

Ottawa.

Rep. 1863, p. 813—*Quins Point in Petite Nation.*
Rep. 1899, p. 136 J *Large quarry between Papineauville and Montebello. Exposure of white sandstone on Lot 17, Con. I, West Templeton.*

Pontiac.

Rep. No. 977, 1907, p. 29—*Quarried for local building near the village of Quio.*

St. Maurice.

Rep. 1863, p. 799 -*Quarried at the Grais rapids on St. Maurice river. Blocks 12 to 18 in. by 20 in. by 4 ft. Used for furnace hearths.*

Soulanges.

Rep. 1895, p. 71A—*One mile south of Ste. Anne de Prescott. Hill north of Ste. Marthe extends towards Ste. Justine de Newton.*

Two Mountains.

Rep., 1863, p. 813—*Ste. Scholastique. The beds are fine grained white, very even, and of varying thicknesses, some as much as two feet.*

Rep., 1888-89, p. 125 K *Good beds at Ste. Scholastique and also between Lachute and St. Jerome.*

The only really serious quarrying for building stone has been conducted near the village of Beauharnois and between Papineauville and Montebello on the Ottawa river. These two localities were visited and are described below as the Beauharnois and Ottawa River areas.

BEAUHARNOIS AREA.

The more important openings that have been made in the Potsdam-Beekmantown sandstone in the county of Beauharnois are situated to the southward of the river road west of the village of Beauharnois in the township of Marystown. The stone is exposed more or less continuously for a distance of three miles west of the village. Quarries have been worked on River St. Louis near the village and towards the western end of the exposures. The western quarries now being worked are on the properties of Octave Allard and Euclide Mompetit. The quarry on the river belongs to William Robert.

Euclide Mompetit, owner, Beauharnois; Sir Donald Mann, operator, Toronto, Ont.

On this property, which is the most westerly now being worked, the stone is exposed in the face of a small escarpment which runs parallel to the road and rises about 10 or 15 feet above the lower level. The beds are practically horizontal and present the following section in descending order:—

2 ft.—Soil.

2 ft.—Hard white flinty bed, brown spotted in places, much shattered (607).

2 ft.—Hard bed, bluish with grey bands, somewhat less shattered (608).

2 ft.—Hard bed like 608 but more stained with iron.

2 ft.—Similar stone but less shattered. Blocks could be got here.

2 ft.—This bed is similar to the next below and in places the two are united.

2 ft.—Fairly uniform greyish white sandstone, the best building bed (609).

The upper stone is so badly shattered that the jointing systems can not be determined. In the lower beds however the major joints are vertical and strike S. 35°E. A minor set crosses E. 10°N. The lower beds are the only ones suitable for building purposes both on account of the quality of the stone and the absence of excessive fracturing. Even in these beds the joint faces are covered with skins of iron oxide and none of the product is equal to the better grades of Potsdam-Beekmantown sandstone from Ontario.

The stone: No. 609.—In the selected hand specimen this is a hard white sandstone with a slight cast of blue. It is composed almost entirely of rather rounded grains of quartz averaging about a quarter of a millimetre in diameter, but in some cases they are a full millimetre or more in width. The freshly broken specimen shows a whitish argillaceous cement surrounding the grains. The corroded test piece suffers very little alteration but an examination with a lens shows that the cementing matter has almost disappeared.

The physical properties are as follows:

Specific gravity	2.657
Weight per cubic foot, lbs.	161.775
Pore space, per cent	2.46
Ratio of absorption, per cent, one hour	0.834
	0.623
" " " two hours	0.848
	0.683
" " " slow immersion	0.874
	0.813
" " " in vacuo	0.95
	0.85
" " " under pressure	0.95
Coefficient of saturation, one hour	.65
" " " two hours	.72
" " " slow immersion	.85
" " " in vacuo	.89
Crushing strength, lbs. per sq. in., dry	28,100.[1]
" " " " wet	39,600.
" " " " wet after freezing	30,800.
Loss on corrosion, grams per sq. in.	0.00084

The stone is very hard and flinty and is suitable for rock-face work only.

No. 608.—Very similar to No. 609 but it is less bluish, a little softer and marked by blackish streaks parallel to the bedding.

No. 607.—A hard and flinty type spotted with brown oxide of iron.

The output of the quarry is converted into crushed stone. The plant consists of a boiler and steam drill and a No. 3 Gates crusher.

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[1] This result is evidently low. The stone has many flaws which make it impossible to obtain good results. Duplicate tests vary thousands of pounds per sq. in. None of the crushing strength tests are to be regarded as more than rough approximations.

Octave Allard, Beauharnois, Que.

This property adjoins that of Mompetit to the east. The quarry is continuous across both properties and the formational features are identical.

William Robert, Beauharnois, Que.

At the falls on River St. Louis just west of the village of Beauharnois a good section of the sandstone is exposed and some quarrying for building purposes has been done in the past. In descending order the beds are as follows:

18 in. Rough stone, very hard and flinty, with black spots.

18 in. Even bedded stone showing lines of stratification throughout, rather flinty.

2 ft. - Ditto.

18 in.- Ditto.

4 ft.- Solid bed of stone resembling the three layers above but less hard and flinty. Best bed (610).

2 ft.- Thin sandstone and shales.

The formation is nearly horizontal with clean vertical joints S. 10° E. In places these joints are close set, but on the whole they are sufficiently distant to permit the extraction of large stone from the lower bed. Cross joints occur at irregular intervals. An unlimited amount of stone is available and an excellent working face is presented.

The stone: No. 610. -This example is similar to No. 609 but it is softer and less flinty and bluish with very little cementing material. Yellowish stains due to oxide of iron are to be seen in places. Both in the nature of the stone and in the formational features of the bed, this seems to be the most desirable of the Beauharnois sandstones.

Most of the sandstone used for building purposes in Beauharnois was obtained from this quarry. In most cases it is seriously discoloured but this is in part due to using the skin-covered joint plane for the rock-face.

OTTAWA RIVER AREA.

On the north side of the Ottawa river between Papineauville and Montebello there occurs a large exposure of sandstone from which considerable amounts have been quarried in the past. Like most of these sandstone areas the locality has long since been abandoned although much stone is still available.

F. F. Mackay, executor of the estate of Talbot Papineau, 97 St. James Street, Montreal.

On this property the sandstone forms an isolated elevation rising about 40 feet above the general level of the country: it is probably half a mile long by a quarter of a mile wide. On the north, northeast, and northwest sides the face is abrupt exposing a descending section as below:

10 ft. Sandstone beds with ferruginous bands. Parting planes are not continuous but the stone may be easily split at almost any level. The most conspicuous partings occur at intervals of 18 in., 1 ft., 2 ft., 2 ft., 18 in., 1 ft., 8 in. The stone (627) is uniform in appearance.

12 ft. Sandstone beds with ferruginous bands becoming more pronounced on weathering. The stone is disposed in three beds of 4 feet each but it splits easily at almost any level. (626).

15 ft. Covered with debris.

The beds are disposed in an undulating manner with a slight average dip to the southward. A distinct set of joints crosses the formation N. 60° E. A second irregular set runs E. 30° S. Fractured headings and diagonal joints occur in places. This rather severe fracturing is offset in part by the even character of the beds, the persistence of fairly thick stone to the top and the absence of overburden. It must be admitted however that stone suitable for building could be quarried only at the expense of considerable waste. No stone was observed free from ferruginous bands, which become more pronounced on weathering. Very long exposure however tends to reduce the colouration with the production of a more pleasing grey aspect.

The 12 foot bed was worked in a number of quarries at an early date. The upper 10 foot bed has also been quarried in a long line of openings at a more recent date.

The stone: No. 626. This stone in small chips can not be distinguished from the Beauharnois stone described as No. 610. In the large block, however, it is less uniform in grain as coarser streaks occur parallel with the stratification. Brownish bands appear throughout the bed which give rise to yellow discolourations on weathering. This stone and No. 627, which is described below, contain far less cementing material than the Sillery sandstones from Levis or L'Islet.

No. 627. This example does not differ greatly from No. 626 but it is rather more banded with faint greyish streaks. In places the colouration is reddish which gives the stone a more pleasing appearance and suggests the stone from Nepean in Ontario.

The Potsdam-Beekmantown sandstones have been described in greater detail in the first volume of this report on pages 121 to 139. The physical characteristics of the Beauharnois and Papineauville stones are probably very similar to those given for the Ontario stones described on pages 131 to 135 of Vol. I.

Summary Potsdam-Beekmantown Sandstones.

The sandstones of this formation are for the most part hard and even flinty stones: they are normally white but are frequently stained by oxide of iron. When the oxidation of the original pyrite has proceeded slowly, the stone has acquired pleasing shades of yellow and red. More frequently however the iron stains are dark and unsightly and occur in large spots and on the jointing planes of the stone. This stone is adapted to rock-face work only and has been used to some extent for that purpose. The physical properties of a typical example are given on page 120, and a more extended account of the stone of this formation is contained in the first volume of this report. A list of localities of occurrence has already been given but no stone is being raised for building purposes from this formation in the Province of Quebec. The exposures near Beauharnois are being quarried for the making of crushed stone.

Sandstones of the Sillery Formation.

The Sillery formation consists of a series of red and green shales with which are associated hard sandstones of varying colours of which the most abundant is green. The formation has been so severely folded that the strata are now found with vertical or highly inclined dips. The position of these sandstones in the geological column has been the subject of much controversy. It is certain however that they represent early Palaeozoic sediments in the eastern part of the province and in consequence have been ascribed to the Cambrian. More recent investigations however show that they are probably of Beekmantown age. The formation is developed east of the city of Quebec, on the island of Orleans, and over a very extensive area which stretches from the south shore of the St. Lawrence below Quebec southwest to the international boundary. The sandstones occupy but a limited portion of this area, and have been seriously quarried only in the vicinity of Quebec and Levis, although the literature contains references to quarrying for local purposes at other points. Ells states that the formation near Granby is capable of yielding stone similar to that quarried at Quebec. For the purpose of this report however there is only one quarrying area, which might be designated the Quebec-Levis area.

QUEBEC-LEVIS AREA.

A good general description of this area from the economic point of view is given by Ells.

"The Sillery sandstone, found largely developed near the city of Quebec and to the south and east of Levis on the upper side of the River St. Lawrence, is extensively used in construction at both cities. Much of the city wall is built of this stone, as well as the Citadel, while it enters largely into the structure of both private and public buildings. It is for the most part a green or greyish-green rock, which in some places becomes highly quartzose, passing into a whitish weathering, yellowish-brown quartzite. The rock frequently contains small pebbles of quartz and pieces of shale of various colours, the quartz pebbles sometimes becoming sufficiently numerous to constitute a fine conglomerate. Certain portions of the rock quarry readily, but it is said not to weather uniformly and does not resist atmospheric influences so well as the Potsdam sandstone. Used by itself in large buildings, its dark-green shade tends to give the structure a heavy and not pleasing aspect but the dark colour blends well with lighter material. This rock is very widely distributed along the south side of the St. Lawrence below the mouth of the Chaudière, and is found at many places inland. Quite extensive quarries exist at Sillery, about four miles southwest of Quebec, and also from one to two miles southeast of Levis, where large quantities of stone of almost any desired size can be obtained. About St. Raphael and Armagh and at certain points near the coast below L'Islet the beds are highly quartzose, and often have a purplish-red colour, which contrasts well with the sombre tint of the typical Sillery rock."[1]

Dr. J. T. Dussault, owner, Philippe Samson, operator, St. Davids, Que.

This property of six acres is situated in the parish of St. Jean Chrysostome, county of Levis, about a mile south of the church at St. Davids.

The quarry is opened on the north side of a hill which rises 60 feet above the flat land. The general level of the country is lower on the south side of the hill, permitting the exposure of a face of 125 feet. The present workings are 200 feet by 100 feet with a face of 60 feet as stated above. The stone is very heavily bedded, in fact the partings more resemble fractures than planes of original stratification. The strike is a little south of east and the dip variable but averaging 20° to the south. The main joints are approximately east and west with a dip of about 80° to the northward. A second set crosses at right angles, vertically. Additional irregular and diagonal fractures are also much in evidence. Despite the jointing, large blocks of stone can be obtained but there is a large amount of waste. The stone is of a fairly uniform dark greenish colour but it is marred by the frequent inclusion of pieces of greenish shale of two or more inches in diameter. Reddish veinlets traverse the stone irregularly and there are also some coarse pebbly streaks. The joint planes are covered with yellowish oxidized films.

The stone: No. 571.- This is a hard coarse sandstone with a greenish colour; it is shown in Plate LI, No. 5. The grains consist largely of quartz of a bluish tint which are sometimes as much as three or four millimetres in diameter. There is also a considerable number of red feldspar grains of about the same size. These larger grains are imbedded in a matrix of smaller grains and a greenish cementing material. The physical characteristics of the stone are given below:

Specific gravity....................................	2.71
Weight per cubic foot, lbs....................................	166.674

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[1] Geol. Sur. Can., Rep. 1888-89, p. 125 K.

Pore space, per cent		1.17
Ratio of absorption, per cent, one hour		0.246
" " " two hours		0.461
" " " slow immersion		0.494
" " " in vacuo		0.514
" " " under pressure		0.553
Coefficient of saturation, one hour		.445
" " two hours		.588
" " slow immersion		.893
" " in vacuo		.93
Crushing strength, lbs. per sq. in., dry	27,000	
" " " " wet	18,120	
" " " " wet after freezing	16,800	
Transverse strength, lbs. per sq. in	2,740	
Shearing strength, lbs. per sq. in	2,174	
Gain on corrosion, grams per sq. in		0.00143
Drilling factor, mm	16	

The corroded specimen showed no appreciable change; the slight gain in weight is doubless due to oxidation. The severe loss in strength when wet is a property common to most sandstones. The small pore space is remarkable as well as the high drilling factor which was so unexpected that the operation was repeated several times. The chiselling test was not made but there is every reason to believe that it would be low and not at all in accord with the high drilling factor.

The iron is nearly all in the lower state of oxidation as Leverin found only a trace of ferric oxide and 3.47 per cent of ferrous oxide.

The rock is quarried by black powder and is cut by plug and feathers. One hand derrick, one horse derrick and a small portable engine and crusher are installed. Small cars running on a short line of track are employed to convey the stone to the crusher. Ten men are employed the year round. The stone is valued at $1 per cubic foot delivered in Quebec. The average output is said to be 3,000 cubic yards per annum.

Stone from this quarry, or from adjoining properties now idle, has been used in many structures of which the following will serve as examples:

Church, St. Davids.
Hospice St. Joseph, Levis.
College, Levis.
Basement of parliament buildings, Quebec.
Drill shed, Levis.

The church at St. Davids shows that the stone retains its dark colour, as many years of weathering have lightened the tone but little.

M. P. Davis, Ottawa, Ont

Excellent exposures in which the Sillery sandstone may be studied have been revealed by the numerous rock cuts in connexion with the approach to the Quebec bridge. The formation is seen to consist of a series of shales and sandstones dipping S. 10°E. at 60°. The main joints are parallel to the strike with a second series down the dip. Numerous other fractures have divided the stone in all directions making the extraction of large blocks possible only at the expense of an enormous waste. Nevertheless pieces, 6 × 3 × 4 feet have been obtained.

The great bulk of the sandstone is of a light green colour inclining to greyish in places (572). Purplish varieties are also seen interbanded with dirty reddish shales. The stone which has been removed in connexion with the engineering work has been crushed or used for filling. Immense amounts are available in the hills between the Quebec bridge and Sillery but it is questionable if present economic conditions will permit the quarrying of this material for building purposes.

The stone: No. 572. A hard sandstone of a dirty green colour. The grain is considerably finer than in the stone from Levis already described. On examination with a lens the quartz grains seem to be imbedded in a light greenish cement which contains flakes of white and black mica. A small amount of carbonate of lime is present. This stone is somewhat softer and a little lighter in colour than No. 794 from L'Islet, but it is essentially similar. See page 127 for microscopic examination.

Jean Vezina, Neilsonville, Que.

A small quarry has been opened in the Sillery sandstone at this point. The product is crushed for macadam and concrete.

Stone from Levis and Cap Rouge was used in the construction of the citadel and in many of the older buildings in Quebec. The excellent wearing qualities of the stone is proved by the present appearance of these structures, which have suffered remarkably little by the lapse of time (Frontispiece; Plate XII).

L'Islet.

The exposures of sandstone along the river below L'Islet have been mentioned in the literature of the subject as a possible source of building stone. Although some of this material has been used locally for building and for macadam, actual quarrying operations have been very limited in extent. A small quarry is situated on the river road two miles below L'Islet. The formation in the vicinity consists of a series of red and green shales with interbedded layers of sandstone. The whole series dips N. 20°W. at an angle of about 25°. Plenty of sandstone is available in beds of varying thickness: most of it is greyish green in colour (794) but red varieties (795) and purple types (796) may be procured in limited quantity. I was unable to learn of any ledges yielding the red and purple stone in quantity. The stone appears to be much shattered and to be cut by white veinlets: it seems to weather rapidly and to become stained by the oxidation of the iron content.

The stone: No. 794. A hard greenish sandstone of darker appearance than the stone from near the Quebec bridge. Under the microscope it is seen to be composed of quartz grains, the largest of which are about one millimetre in diameter but the general average of the grains is much less and would not exceed ¼ mm. A small amount of feldspar in a fairly fresh condition is mixed with the quartz fragments and the whole is cemented by an appreciable amount of indeterminable material in which secondary greenish chlorite occurs in places. This chlorite has apparently arisen by the alteration of some original ferro-magnesian constituents. The quartz and feldspar grains are very closely apposed and in consequence the rock should prove very durable, but it would be hard to work.

No. 795. A light pink to rose coloured sandstone of very compact structure. The grains are of even size, small, rounded, and are cemented in a considerable amount of fine indeterminable cement which is probably siliceous. The grains are larger and more rounded than in No. 794. The stone presents a clean and attractive appearance with slight evidences of banding. It is very hard, almost like a quartzite, and could not be chiselled except at prohibitive cost. For rock-face work however the stone is a desirable material.

No. 796. This stone is of a dark reddish chocolate colour and is very hard and flinty. It is composed of quartz grains with a considerable amount of feldspar, the subsequent oxidation of which causes the stone to show minute white specks in the more altered parts. The colour is due to the large amount of ferric oxide in the cementing matter. Veinlets of white quartz cut the stone in all directions.

The hard greenish grey sandstone in the church and school in L'Islet was obtained in the vicinity.

Fraserville.

At Fraserville (Rivière du Loup) hard coarse grained sandstones are quarried for macadam and concrete work.

The stone: No. 810. This stone consists of large, sharply angular fragments of bluish quartz and white feldspar cemented in a matrix of finer quartz and feldspar grains and greenish-grey indeterminable matter.

No. 811.—Like No. 810 but darker and of somewhat finer grain.

Both varieties are badly shattered and could not be quarried in large blocks. The stone is coarse and not of handsome appearance but it would probably prove very durable.

Summary—Sillery Sandstone.

The Sillery formation, which occupies a wide area in southeastern Quebec, consists of red and green shales with which are associated hard sandstones of similar colour. These sandstones occur, more particularly in the neighbourhood of Quebec and Levis and at L'Islet. The stone at the former locality is mostly of a greenish colour and rather coarse-textured but it was extensively used for building in the early days of the city of Quebec. The stone is hard and not suited to fine carving but it is very durable and retains its dark greenish colour almost unaltered after years of exposure. The properties of an average sample are given on page 124.

The L'Islet stone is similar to that of Quebec but it presents greater variations in colour. No stone is quarried at this latter locality. Frontispiece; Plate XII.

Literature: Geol. Sur. Can., Rep. 1863, p. 814.
Geol. Sar. Can., Rep. 1888-89, p. 125 K.
Geol. Sur. Can., Rep. 1894, p. 89 J.
Twelfth Int. Geol. Congress, Guide Book No. 1, 1913, pp. 30, 52.

Sandstones of the Trenton Formation.

The Trenton limestones on the north shore of the lower St. Lawrence river are underlaid in places by a sandstone which is of very irregular development and which was long considered to represent the Potsdam-Beekmantown formation. It is now believed, however, that these beds are a basal sandstone belonging to the same series as the accompanying Trenton limestones. The strata are best shown at Malbaie and Baie St. Paul. As quarrying operations were at one time carried on at Murray Bay and as the excellent shipping facilities recommend the locality, a somewhat detailed account of the exposure is given.

MALBAIE AREA.

To the westward of the wharf at Murray Bay (Malbaie) the rocks consist of a series of dark mica schists with gneissoid bands striking due northeast and dipping northwest at an angle of about 30°. East of the wharf the Pre-Cambrian rocks are covered by Palaeozoic sediments which extend from the water level to a height of 100 feet or more. (Plate XIII). The railway runs along the face of the cliff at a height of about 20 feet above the water. Between the water level and the road bed, the following beds are presented in ascending order:

Dark limestone (797).

6-8 ft.—White beds (798).

6-8 ft.—Dark limestone in thin beds (799).

6-8 ft.—Stone like No. 798 in irregular beds, almost a conglomerate in places.

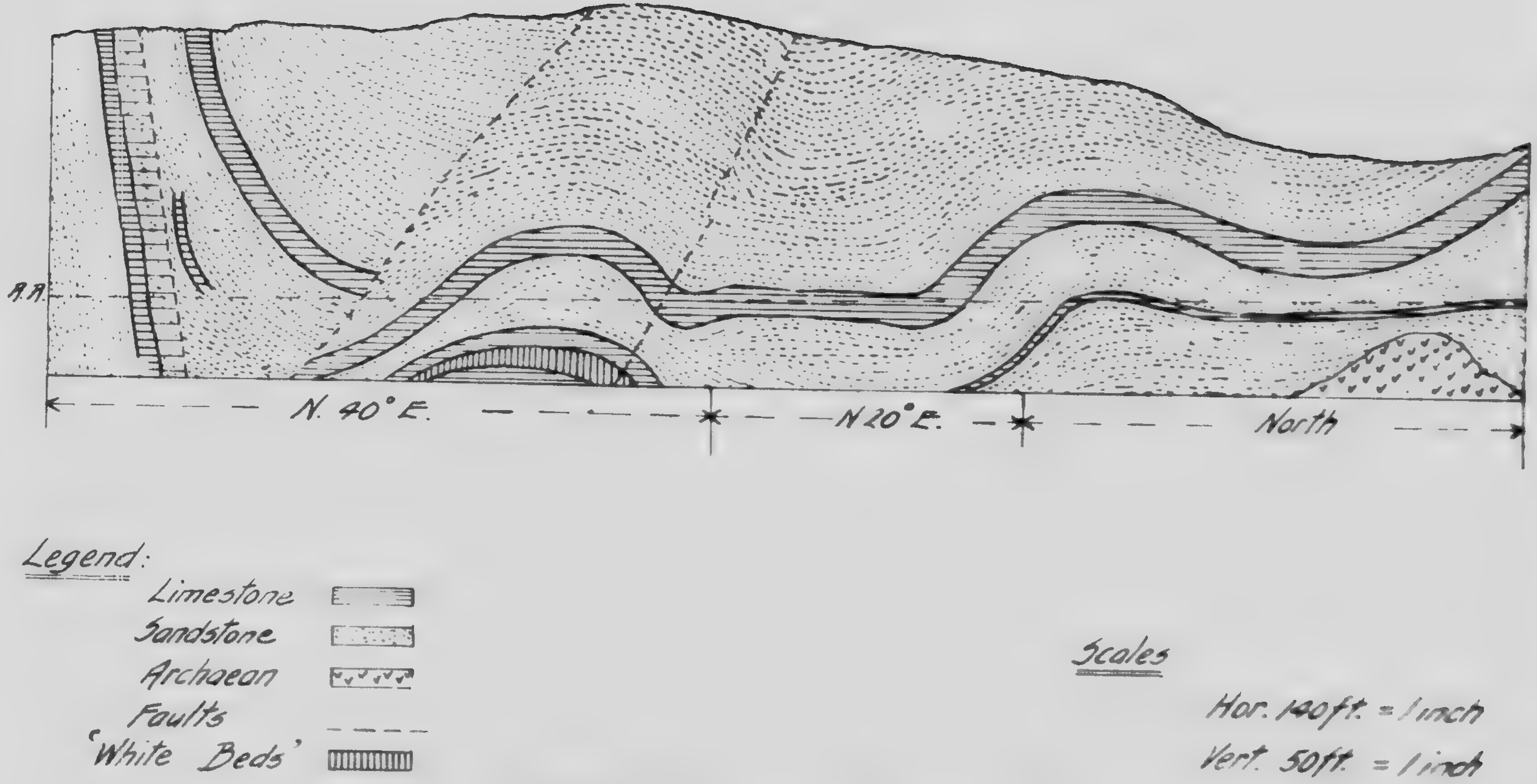

Fig. 5. Section show[illegible] of the [illegible] M[illegible]

Above the track a cliff of 75 to 100 feet continues in a northeasterly direction along the shore. The sedimentary beds have been sharply upturned against the Pre-Cambrian axis, folded into synclines and anticlines and broken by several faults. A general idea of the formation may be gained from the accompanying sketch, Figure 5, and the following notes on the section along the coast.

S. 40° W. to N. 40° E.

28 paces- Coarse sandstone, followed by thin blue limestones striking N. 30° W. and dipping vertically.

9 paces - Whitish, thin bedded grits and calcareous sandstones, dipping 70° to the northeast.

Fault striking N. 30° W. and dipping at a high angle to the northeast.

8 paces—Thin bedded fossiliferous limestone, striking N. 10° W. and dipping to the east (800).

39 paces- Hard grits and sandstones with some thin limestones, presenting a rapidly decreasing dip. At the end of the section the beds are horizontal showing 6-8 feet of limestone covered by about 75 feet of varied sandstones to the top. This segment therefore shows (1) a lower limestone, (2) a middle grit, (3) an upper limestone, (4) an upper sandstone.

Fault striking northwest and dipping 22° to southwest.

60 paces—On this stretch the beds dip westwardly but the crown of an anticline is reached at the end. Here the top of the upper limestone is about 20 feet above the track, thus exposing the lower grits.

21 paces-- The formation turns sharply down and shows that the beds are disposed in a dome-like manner with a dip of 30° towards the river.

17 paces--The upper blue limestone appears at the level of the track, strikes N. 20° E. and dips 22° to the northwest. The formation rises to the eastward and is covered by 20 feet of sandstone.

From S. 20° W. to N. 20° E.

20 paces—The blue stone is about 20 feet thick and is covered by 20 feet of standsone (801).

41 paces—Top of blue limestone is now 4 feet above track.

28 paces—Bottom of blue limestone 20 feet above track; middle sandstone down to track.

South to North.

62 paces -The lower limestone appears at the level of the track; it strikes north and dips 30° to the west. The middle grits reach 10 feet above the tracks and are covered by 10 feet of the upper limestone and 10 feet of the upper sandstones.

50 paces The beds dip westward at a low angle and wrap around an exposure of a greenish serpentinous rock of the Pre-Cambrian which rises to a height of about 15 feet above the level of the water.

This mixed sandstone and limestone formation continues with a low but varying dip and less prominent exposures to a point about 50 yards beyond the lower wharf, where it is overlain with a pronounced unconformity by a more uniform limestone formation which at first strikes W. 10° S. and dips northwards at 30°. A short distance beyond the contact these upper beds strike north and south and show a dip of 10° to 15° to the west (806). This formation continues well into the bay and must have a considerable thickness. Across the bay in a direction N. 50° E. the sandstone formation again appears in prominent cliffs.

The mixed character of the formation and the excessive folding and faulting which the rocks have suffered render the successful quarrying of the stone rather uncertain. The upper beds present the most promising possibilities but there is a discouraging amount of fracturing and great variation in the character of the stone which by a gradual increase in the amount of lime pass from rocks which are almost quartzites through various phases of calcareous sandstones to beds which are nearly pure limestone.

The workable sandstones may be considered as presenting four general types as below:

No. 802 -Typical hard white.
No. 803 -Typical brecciated white.
No. 804. -Typical dark type; honeycombs on weathering.
No. 805. -Typical banded type.

The stone: No. 797. —A hard, fine grained limestone resembling in both colour and structure the stone from Beauport shown in Plate LI, No. 1. It breaks with a splintery fracture and shows numerous fine veinlets of secondary calcite.

No. 798. —This is the same stone described below as No. 802.

No. 799.—This stone is hard and dark grey in colour: it consists of a base of dark coloured, fine grained limestone in which are well rounded grains of quartz up to a millimetre in diameter. In places the quartz grains are so numerous that the stone might be described as a calcareous sandstone. This rock is rather rough and represents a transition between the sandstone and the limestone.

No. 800.—A dark fine grained limestone practically identical with No. 797.

No. 801. A rather hard greyish limestone of the semi-crystalline class very closely resembling the stone from Grande Ligne shown in Plate L, No. 8. The grain is finer however and small fragments of a fine grained stone like No. 797 are scattered through the more crystalline and coarser ground mass. Other parts of this bed are of darker colour, finer grain and less crystalline structure: they show transitions to the type described as No. 797.

No. 802.—This is a medium grained, whitish grey sandstone with clouds of a darker colour. Plate LI, No. 9, shows the average appearance of the stone with one of the darker clouds across the middle of the figure. The grains average about a half millimetre in diameter but some of them are much larger: they are all well rounded and are imbedded in an abundant cement of carbonate of lime. The stone is rather hard but it possesses a uniform grain and represents the best product of the exposure. The dark clouds seem to be due to a difference in the colour of the quartz grains rather than to a difference in the composition of the cement.

No. 803. This is a hard, compact, fine grained, sandy limestone resembling in colour No. 802 described above. The purer parts are comparable in colour and structure with the Lowville stone from the base of the exposure at Pointe Claire described on page 50. The more sandy portions contain numerous rounded quartz grains of about one mm. in diameter. This bed is doubtless a more calcareous part of the bed from which No. 802 was derived, and doubtless passes into it by insensible gradations.

No. 804.—A sandstone comparable with No. 802 in general structure but somewhat coarser with more large rounded grains of quartz. The colour is quite different, however, as the present stone is distinctly grey rather than whitish in appearance. It is a rougher and less desirable material than No. 802.

No. 805.—This sandstone is like No. 802 in structure but it shows bands resembling No. 804. It is a harder and more indurated stone than No. 802.

No. 806.—A fine grained, thin bedded, black, clayey limestone, resembling the black Trenton limestone from Montreal. It is much softer than the Montreal stone and darker in colour than No. 797 which it resembles in structure.

The church at Murray Bay is built of the local sandstone and it presents a rough but rather attractive appearance despite the variation in the colour of the stone which has been derived from different beds. The building shows that the sandstone is of a high order of durability, as sills and copings which have been cut show the chisel marks as plainly as when the work was done. Murray Bay sandstone may also be seen in the court house in Quebec.

The limestones lying in the bay to the east of the village (No. 806) are too soft and argillaceous to be of value as building material but they may find a local application for foundations and rough walls.

This rather long account of the formation at Malbaie is justified by its proximity to the city of Quebec and by the absence of any other source of supply of like material.

Sandstones of the Niagara Formation.

LAKE TIMISKAMING AREA.

Routly and Summers, Haileybury, Ont.

This firm has acquired lots 18, 19, 20 and 21 in the first concession of Guigues on the east shore of Lake Timiskaming north of Piché point.

A band of sandstone representing the basal portion of the Silurian system as developed in this district reaches inland for about a quarter of a mile. The trend of the shore is a little east of north and the beds of sandstone are disposed in a series of gentle anticlines and synclines which produce a varying dip in the exposures along the shore.

On the point where the first work was done the beds dip N. 10°W. at 10°. The succession of beds exposed here is as follows in descending order:

2 ft. 2 in.
1 ft. 6 in.
1 ft. 2 in.
2 ft. 2 in.
3 ft. 4 in.

The most pronounced joints are down the dip: they are widely spaced and would not interfere with quarrying. All the stone presents a yellowish grey appearance and in places it is very coarse and pebbly: it would be difficult to obtain blocks free from this objectionable feature. Another characteristic of this stone is its tendency to weather into a coarsely honeycombed surface which is very peculiar. This feature seems to be due to a variation in the nature of the cementing material which shows a yellow and grey component of which the former is the more resistant. This peculiar structure is present in some layers to a greater extent than in others but it is not entirely absent from any of the stone at this point (937).

About 100 yards north of this exposure the stone rises to a height of 30 feet above the water and presents higher beds both on account of greater elevation and on account of the inclination of the strata. The beds here are thick, less pebbly and without the differential weathering described above. The quarry could be advanced some distance inland at this point without a prohibitive overburden. The stone (939) is soft and easily quarried but it hardens on exposure Farther north the strata are almost level and rise to still greater heights presenting many points at which quarrying could be carried on.

This locality is described by T. C. Denis thus:[1] "Some stone was extracted from the quarry on lots 18, 19, and 20, range I, of Guigues township, on the shore of Lake Timiskaming, and used for buttress capitals, coping stone, etc., for the new Presbyterian church at Haileybury.

"This stone is quarried from a rim of the Niagara formation which rests directly on the Pre-Cambrian, and which outcrops from Piché point on Lake Timiskaming, northward for a distance of about three miles. The stone is of a pleasing buff colour and dresses easily."

The stone: No. 937.—This stone does not differ greatly from No. 939 described below and figured in Plate LI, No. 12. The dolomitic part is essentially the same but the sand grains are rather finer; in places, however, it is fully as coarse as the other example.

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[1] Dept. Col. Mines and Fish., Quebec. Rep. Min. Op., Que., 1911, p. 32.

A microscopic examination shows the following structure:

Ground mass—crystalline dolomite, the grains averaging about ¼ mm. in diameter. A small amount of uncrystallized matter coating the crystals of dolomite.

Pore space—Large interstices are quite visible; the pore space would probably be 15 to 20 per cent.

Quartz grains—The grains of quartz are sharply angular and average about one half mm. in diameter. In the section examined they make up about one-quarter to one-third of the field.

No. 939.—A medium to fine grained, crystalline, porous dolomite with a large percentage of quartz grains in angular fragments of much greater size than the crystals of dolomite. The stone is shown in Plate LI, No. 12. The quartz grains are very angular and considerably larger than in No. 937 but otherwise the two stones are the same. Both of these rocks are sandy dolomites rather than sandstones and well might be included with No. 938 from Burnt Island described under the limestones on page 114.

An analysis of the stone by Leverin gave 0.29 per cent ferric oxide and 0.51 per cent ferrous oxide.

This stone as stated above has been used in the Presbyterian church in Haileybury for trimmings: it has assumed a yellowish and somewhat iron stained appearance. The product of these quarries will doubtless be employed for local building but the grain is too coarse and variable and the content of unoxidized iron too great to justify the working of the quarries with a view to shipping the stone to a distance (Plate XIV).

Sandstones of the Devonian System.

The Devonian sandstones of Gaspé have frequently been referred to as a source of supply for building purposes. The inaccessible nature of the interior of the Gaspé peninsula has prevented the exploitation of these stones but it is rather remarkable that the occurrences along the line of the Intercolonial railway have not received greater attention. Sandstones associated with shales are encountered near Causapscal station in a belt about six miles broad which extends to the extremity of the Gaspé peninsula, a distance of 150 miles.

CAUSAPSCAL AREA.

The best known exposures of the Devonian sandstones of Gaspé occur to the west of Causapscal station on the line of the Intercolonial railway where they were quarried at the time of the construction of the line. These quarries have not since been worked but they are worthy the attention of persons interested in the building stone industry.

A. Lajoie, Matalik, Que.
Joseph Heppel, Matalik, Que.

The above gentlemen own lots 24 and 25 in the first range of Causapscal South, Rimouski county. A considerable amount of stone was obtained here by the Intercolonial railway for use along the line and some was shipped to Montreal for building purposes.

The opening is on the south side of a small stream and presents a face of about 75 feet. The old excavation is 150 feet long and has been worked back to a depth of 50 feet. In places it is difficult to distinguish bedding and jointing as the stone is of very uniform character. In other parts of the quarry however the bedding is more apparent and the stone is of a more reedy nature with occasional white blotches. The beds seem to strike W. 20° N. and to dip 75° to the southward. The most pronounced joints dip a little north of west at a low angle and might easily be mistaken for bedding planes. Towards the bottom of the quarry these joints are widely spaced but near the top they are so frequent that a large amount of stone is rendered worthless. Three feet was the maximum thickness observed but 10 to 18 inch material may be obtained in abundance. Cross joints are infrequent and irregular. Above the main quarry is a smaller opening presenting much the same features but with some widely spaced vertical joints striking north and south. On the opposite or northern side of the creek are exposures of the same stone but no work has been done on this side. The stripping is slight but about 20 feet of the upper stone is badly fractured and must be considered as overburden. The quarry is in bad condition at present as it has not been worked in many years. There can be little doubt however that a large supply of a very desirable freestone is obtainable at this point

The stone: The general colour of the stone is excellent and for the most part it is remarkably uniform: long exposure to the weather has produced no effect beyond a slight darkening. There are few, if any, veinlets or soft spots and shaly partings are only occasionally present.

No. 826.—This specimen was selected from the waste material in the quarry: it must be remembered therefore that the stone has been subjected to the action of the weather for many years. It is a fine grained, uniform, brownish red sandstone of very attractive appearance (Plate [illegible] No. 10). Under the microscope it is seen that the grains are chiefly of quartz varying in size from minute fragments up to grains about a half millimetre in diameter. Mingled with the quartz grains are fragments of a similar size which show evidence of considerable alteration making their original nature difficult to determine: in all probability these grains are feldspar. The constituent grains are closely apposed and are surrounded with a film of oxide of iron in which occasional flakes of chlorite occur. The corrosion test reduces the brightness of the red and gives the stone a slight tinge of yellow.

The physical properties are as follows:

Specific gravity	2.689
Weight per cubic foot, lbs.	160.64
Pore space, per cent.	3.15
Ratio of absorption, per cent, one hour	0.391
" " " " " two hours	0.581
" " " " " slow immersion	1.136
" " " " " in vacuo	1.165
" " " " " under pressure	1.21
Coefficient of saturation, one hour	.323
" " " two hours	.354
" " " slow immersion	.94
" " " in vacuo	.964
Crushing strength, lbs. per sq. in., dry	31,200.
" " " " " " wet	18,750.
" " " " " " wet after freezing	22,800.
Transverse strength, lbs. per sq. in.	913.
Shearing strength, lbs.per sq. in.	1,740.
Loss on corrosion, grams per sq. in.	0.000409
Drilling factor, mm.	10.2
Chiseling factor, grams	2.4

The stone contains 1.57 per cent ferric oxide and 1.41 per cent ferrous oxide.

It will be observed that the crushing strength for the frozen cube is higher than for the wet one: a second wet cube was tested but it failed to raise the figure given above. It is evident however that the wet and not the frozen cube is in error.

This Causapscal stone is a very desirable material on account of the fineness of grain and the uniformity of colour which is very like that of the brown Credit Valley stone from Ontario. The quarries were worked for about nine years and a force of 200 men was employed. It is much to be regretted that this stone is not now in the market for it could be employed to advantage in repairs and additions to buildings constructed of Credit Valley brown freestone which is no longer procurable in quantity.

Sandstone of the Carboniferous System.

Sandstones of the Carboniferous formations which are so largely quarried in the provinces of New Brunswick and Nova Scotia are sparingly developed at a few points along the north shore of the Baie des Chaleurs in the province of Quebec. The most important belt and the only one in which any serious quarrying has been attempted lies in the vicinity of Pointe à Bourdeau opposite Campbellton, N. B.

PLATE XV.

Carboniferous sandstone. Old quarry at Pointe à Bourdeau, Que.

POINTE À BOURDEAU AREA.

T. R. Busteed, Pointe à Bourdeau, Que.; Lot 1, Range 1, Mann.

On this lot and on adjoining lots a somewhat coarse Carboniferous sandstone of the olive-green class has yielded a considerable amount of building stone. The formation strikes N. 60° E. and dips 50° to the southeast. The most pronounced joints strike N. 30° W. and dip 10° and 15° to the southwest.

Three old quarries are situated at a considerable elevation above the water towards the west end of the outcrop. The chief of these old workings presents the following succession in ascending order:

1-15 ft.—Sandstone with numerous irregular friable bands (822).
0-6 ft.—Irregular conglomerate bed.
20 ft.—Sandstone in very irregular beds.
5 ft.—Conglomerate.
Thin sandstones.

Narrow bands of shale occur throughout the formation and may be seen on the face which is about 50 feet high with an additional 20 feet under water (Plate XV). The formation appears to be badly shattered but this is doubtless due to long exposure. It is stated that good blocks were obtained by following the bedding and jointing.

The stone may be seen in the Mission church at Mission Point on the Restigouche river opposite Campbellton, N. B.

Mr. Busteed is opening a new quarry at a point farther east and at a lower level. The stone was not well exposed at the time of my visit as little work had been done.

The upper layer is a coarse conglomerate under which heavy bedded sandstones occur. These beds are broken into thin material by irregular partings but it is hoped that the formation will prove more solid as quarrying operations advance. Rough stone (821) has been shipped for filling cribs. The output can be readily shipped from the wharf close at hand. Four men are employed.

The stone: No. 822.—The colour and grain of the rock are shown in Plate LI, No. 11. The component fragments are quartz, feldspar and indeterminable matter of a dark colour. Some of the quartz grains are reddish and the feldspars are badly decomposed: the indeterminable rock fragments are black, and like the other grains are well rounded. The cement is rather abundant and consists almost entirely of argillaceous matter. The large amount of cement and the decomposed condition of the feldspars give a "dirty" effect to the microscopic section. The corrosion test produces very little change in the colour of the stone.

The physical properties are as below:—

Specific gravity (in duplicate)	2.702 2.724
Weight per cubic foot, lbs	150.29 150.731
Pore space, per cent	10.9 11.36
Ratio of absorption, per cent, one hour	1.0005 .98
“ “ “ two hours	1.223 1.29
“ “ “ slow immersion	3.22 3.11
“ “ “ in vacuo	4.48 4.15
“ “ “ under pressure	4.53 4.71
Coefficient of saturation, one hour	.23 .20
“ “ “ two hours	.27 .28
“ “ “ slow immersion	.7 .66
“ “ “ in vacuo	.96 .98
Crushing strength, lbs, per sq. in., dry	14,970.
“ “ “ “ wet	8,640.
“ “ “ “ wet after freezing	8,140.
Transverse strength, lbs, per sq. in	1.745
Shearing strength, lbs. per sq. in	995.
Loss on corrosion, grams per sq. in	0.000178
Drilling factor, mm	22.4
Chiselling factor, grams	8.

Leverin found that the stone contains 3.73 per cent of ferrous oxide and only a trace of ferric oxide. This indicates that the exposed stone would be subject to staining.

No. 821.—In the hand specimen this rock does not differ greatly from No. 822. The grain is slightly finer and the colour slightly more yellow and somewhat variable.

CHAPTER V.

GRANITES AND GNEISSES OF THE PROVINCE OF QUEBEC.

True granites are composed of three mineral constituents orthoclase feldspar, quartz, and mica or some other ferro-magnesian mineral such as hornblende. When a rock of this mineral nature presents a laminated structure with the constituents more or less distinctly arranged in layers it is known as gneiss. By a failure of the quartz constituent, granite passes into syenite. In the present chapter it is proposed to consider the true granites and gneisses and such of the syenites as resemble granites in their general appearance. Certain members of the syenite family which less resemble typical granites will be considered in the chapter dealing with the black granites and other igneous rocks.

Granite and its allies, restricted as above, are quarried in two general regions which are very dissimilar geologically. The ancient Pre-Cambrian crystalline area of northern Quebec contains enormous ranges of granite and granitoid gneisses the application of which to structural purposes is only in its infancy. In this great region the following quarrying areas may be established in accord with the present development of the industry:

Rivière à Pierre area.
Roberval area.
Ottawa area.
Argenteuil area.
St. Jerome area.

The second general region is in the southern part of the Eastern Townships where granite is quarried from igneous masses of later age than the surrounding sedimentaries. The important areas may conveniently be arranged as below:

Stanstead area.
Magoons Point area.
Megantic area.
Stanhope area.

Granites and Gneisses of the Northern Pre-Cambrian Region.

RIVIÈRE À PIERRE AREA.

The granitic mountain lying east of the line of the Lake St. John railway near Rivière à Pierre in Portneuf county has yielded structural and monumental stone at several points. The chief operators are Joseph N. Perron, Fortunat Voyer, and Dumas Frères.

Joseph N. Perron, Rivière à Pierre, Que.

The property consists of about 10 acres on the mountain side immediately east of the track and south of the station at Rivière à Pierre.

The hill is approximately 250 feet high and the opening has been made at an elevation of about 150 feet. The quarry is about 150 feet long and has been worked into the hill a distance of 50 feet. The present face is 25 feet high but this will rapidly increase if the workings are extended (Plate XVI).

The rock lies in very heavy sheets: the one being worked is 20 feet thick and another of like thickness lies above it. Somewhat variable joints cut the formation at intervals of 8 to 20 feet and dip at about 70° S. 20°E. A second set with nearly vertical dip strikes southeast. The rift is horizontal and independent of the sheeting which in places is inclined at about 15°. The grain is well developed and vertical in a direction a little east of north. The stone is said to split with nearly equal facility on the rift and grain but to be much harder on the hardway. In quarrying it is found that plug holes 3 inches deep and 6 inches apart suffice for the parting of 3 foot stone, 15 feet back from the face. A slab of 1 foot in thickness can be split by 2½ inch plug holes 10 inches apart.

The stone is of uniform character and shows a slight gnessoid structure throughout (576).

The stone: No. 576. This granite is shown in Plate LII, No. 4: it consists of pure white quartz and feldspar and black hornblende with a less amount of black mica. The stone is capable of receiving a good polish and is not affected by the corrosion test. No microscopic examination was made.

The physical properties are:—

Specific gravity		2.76
Weight per cubic foot, lbs.		171.686
Pore space, per cent		0.355
Ratio of absorption, per cent, one hour		0.0867
" " " " " two hours		0.0867
" " " " " slow immersion		0.0962
" " " " " in vacuo		0.0962
" " " " " under pressure		0.129
Coefficient of saturation, one hour		.67
" " two hours		.67
" " slow immersion		.746
" " in vacuo		.746
Crushing strength, lbs. per sq. in., dry	24,730	
" " " " " " wet	22,400	
" " " " " " wet after freezing	20,430	
Transverse strength, lbs. per sq. in.	2,950	
Shearing strength, lbs. per sq. in.	2,225	
Loss on corrosion, grams per sq. in.		0.00354
Drilling factor, mm.		8

Judged by the drilling factor as given above this stone should be easy to work as the figure is the highest for any of the granites.

Rivière à Pierre granite. Perron's quarry, Rivière à Pierre, Que.

The only equipment on the property is a hand derrick. Fifteen men are employed. Roughly squared blocks are quoted at 50 cents per cubic foot f.o.b. siding. Curbing stones are valued at 55 cents per running foot and paving blocks at $55 per thousand. About 8000 cubic feet were shipped in 1911.

The stone may be seen in the basement of the parliament building, Quebec, and in the Mission des Frères de Limoilou.

Fortunat Voyer, Rivière à Pierre, Que.

This property consists of 640 acres situated on the north side of the mountain about a mile northeast of Perron's quarry. The stone for the Quebec bridge was obtained here from an old opening which was connected by an inclined railway to the spur at the lumber mills below. This old quarry is about 200 feet long and has been worked back an equal distance on the east side but less at the west. The face is 30 feet high and shows an upper sheet of 5 feet followed by a layer which is 20 feet thick at the east end but runs out to the surface at the west; below are thinner sheets of 4, 6, and 8 feet. The sheets appear to dip northeast (N. 20° E.) at from 15° to 20°. The main joints run southeast at intervals of 10 to 20 feet.

The quarry now being worked lies above the 20 foot bed. The upper sheet in the old quarry has increased to 12 feet in thickness and is covered by a layer which varies from 1 to 6 feet in vertical extent. The main joints occur at intervals of 4, 10, and 30 feet. The cross joints are infrequent, permitting the extraction of very large stones. The rift seems to be horizontal and the grain vertical at N. 20° E. The foreman informs me that little difference in splitting is observed in the different directions except a slightly greater difficulty on the hardway. The stone is fairly uniform in character with few knots, but masses of a somewhat darker colour occur in places.

The stone: No. 578.—This is a coarse grained granite with crystals as great as 10 mm. in diameter. The most prominent component is quartz in large clear glassy crystals; potash feldspar is abundant and is frequently represented by the variety microcline. The dark minerals are mostly black mica and hornblende with a little augite and grains of magnetite. The stone is shown in Plate LII, No. 3. The coarser grain, the pink feldspars and the less amount of black minerals distinguish this rock rather sharply from Perron's although it is of very similar structure mineralogically.

The physical properties are:

Specific gravity	2.694
Weight per cubic foot, lbs.	168.176
Pore space, per cent,	0.406
Ratio of absorption, per cent, one hour	0.1134
" " " " " two hours	0.1134
" " " " " slow immersion	0.1134
" " " " " in vacuo	0.131
" " " " " under pressure	0.151

Coefficient of saturation, one hour	.75
" " " two hours	.75
" " " slow immersion	.75
" " " in vacuo	.975
Crushing strength, lbs. per sq. in., dry	29,600.
" " " " " " wet	29,600.
" " " " " " wet after freezing	26,210. (poor test)
Transverse strength, lbs. per sq. in.	1,740.
Shearing strength, lbs. per sq. in.	1,845.
Loss on corrosion, grams per sq. in.	0.00007
Drilling factor, mm.	4.4

The loss of strength on freezing indicated above is probably too great as the test cube failed from one side.

The equipment consists of two hand derricks only. Seventeen cutters and nine quarrymen are employed. The stone has been used for building but the present output is converted into curb stones. These curbs are cut 9 inches thick by 12 inches deep and as long as possible: they are valued at 63 cents per running foot.

M. Voyer has opened a second quarry about quarter of a mile southwest of the large one on a very different kind of stone. The quarry is shallow and is worked in a single sheet about 6 feet thick. The jointing is clear and vertical permitting the easy extraction of stone. The rock is fine in grain but it possesses a gneissoid structure which unfits it for use as a building material. On the other hand, the stone splits with great facility and is therefore adapted to the making of paving blocks.

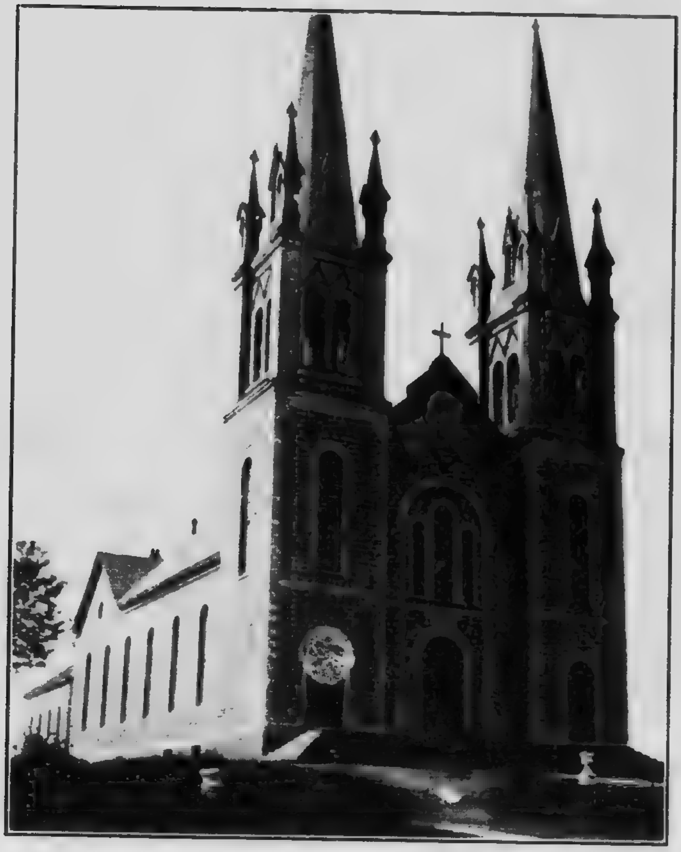
The stone: No. 577.—A fine grained, grey to red, gneissoid granite of variable structure: it is not adapted to building purposes

Dumas Frères, Rivière à Pierre, Que.

This firm controls 275 acres north of Voyer's property. The quarry extends 300 feet along the mountain side and has been worked in 20 feet. The face is 15 feet high and shows a single sheet at this point although this sheet is divided into two beyond a main joint which strikes northeast. A second set of joints at right angles to the above divides the sheet into blocks at intervals of 6 to 10 feet. The stone shows a good horizontal rift which is independent of the slightly inclined sheeting. It is said by the workmen that a grain is scarcely perceptible. The stone is of slightly finer grain than Voyer's but it is practically the same. One derrick is installed. Nine men are employed in making curb stones.

Alex. Doyer, Rivière à Pierre, Que.

This property is situated across the river from Voyer and Dumas. It has been worked on a very small scale for the production of curb stones.



Rivière à Pierre granite. Church at Ste. Thècle, Que.

Summary—Rivière à Pierre Area.

Near Rivière à Pierre in Portneuf county on the line of the Lake St. John railway, a large granitic mass rises above the general level of the country and has been quarried at several points. Opposite the railway station Joseph Perron is operating in a coarse grained dark coloured stone and farther to the northeast several quarries are located on a coarse grained granite containing large pink and white feldspar crystals. A finer type also occurs here but it is of variable structure and is employed for the making of paving stones only.

Rivière à Pierre granite has been used for architectural purposes and also in building railway piers and for curb stones for the city of Quebec. The church at Ste. Thècle is a good example of the use of the stone for structures of an imposing type (Plate XVII).

An immense amount of stone is available at this point which is within a reasonable distance of Quebec and is also directly connected with Montreal by the Great Northern railway.

A detailed description of the darker type of stone from Perron's quarry is given on page 140, and of the coarse stone from Voyer's quarry on page 141.

ROBERVAL AREA.

August Bernier, Roberval, Que.

A small hill of about four acres in extent rises above the general leve. 2½ miles northwest of Roberval. The hill is quite bare and easily accessible for quarrying purposes. The opening extends 200 feet along the east side and exposes an upper sheet of 12 feet, a middle sheet of 10 feet, and a lower sheet of 5 feet in thickness. The middle bed is thicker towards the south (26 ft.) and the lower bed increases northwards. The sheeting is disposed in a dome-like manner conforming with the shape of the hill. The main joints strike W. 50°S.: they are irregular and ill defined but widely spaced. Blocks of any reasonable size can easily be obtained. The rift is horizontal and the grain vertical in an east and west direction. The southern part of the quarry and the main area of the hill show a red variety (579) which is cut by many stringers of fine grained feldspathic material. It would be difficult to obtain large pieces free from this objectionable feature. The red stone is bounded on the east by a coarse grained feldspathic band beyond which a "blue" variety (580) occurs. It is apparent therefore that this blue stone is accessible only in a limited area at the northeast side of the hill. (Plate XVIII).

The stone: No. 579.—This is a very coarse granite of the same general type as No. 578 but with a much greater profusion of red orthoclase feldspar crystals. Quartz is present in smaller individuals and in less abundance than the feldspar, while the black minerals—chiefly biotite (black mica) are in relatively small amount. A few crystals of soda-lime feldspar (plagioclase) accompany the orthoclase. The red colour of the feldspar seems to be secondary and to have been caused by the iron oxide which has been derived from the oxidation of the mica or minerals accompanying it.

The physical properties follow:

Specific gravity	2.653
Weight per cubic foot, lbs	164.959
Pore space, per cent	0.397
Ratio of absorption, per cent, one hour	0.1065
" " " two hours	0.1065
" " " slow immersion	0.1152
" " " in vacuo	0.121
" " " under pressure	0.151
Coefficient of saturation, one hour	.706
" " " two hours	.706
" " " slow immersion	.764
" " " in vacuo	.802
Crushing strength, lbs. per sq. in., dry	30,650.
" " " " wet	28,550.
" " " " wet after freezing	28,600.
Transverse strength, lbs. per sq. in	2,393.
Shearing strength, lbs. per sq. in	1,867.
Loss on corrosion, grams per sq. in	0.00007
Drilling factor, mm	5.3

This stone is very similar to the Rivière à Pierre stone described on page 141 as No. 578.

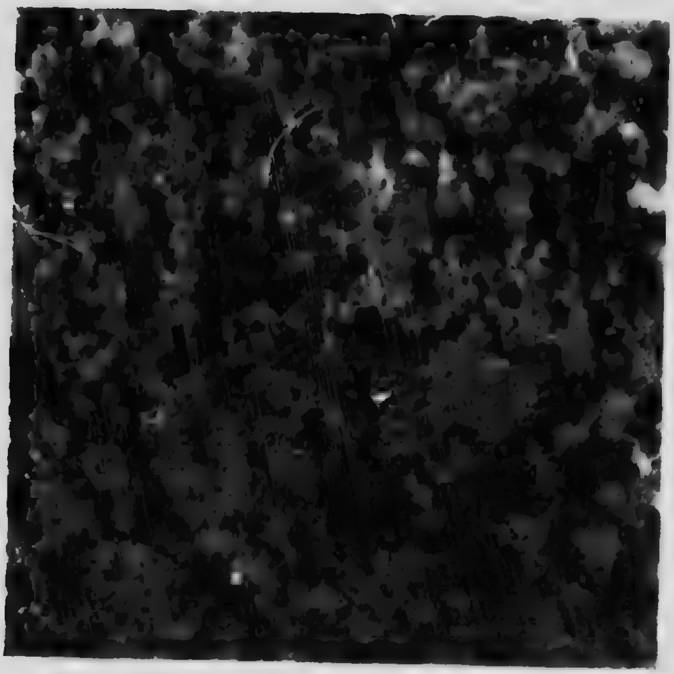
No. 580.—This granite is slightly finer in grain than No. 579 and contains rather more of the ferro-magnesian constituents. The colour is much less red and is shown in Plate XIX. Under the microscope the feldspar proves to be ortholcase in some cases represented by the variety microcline and a small amount of plagioclase, all in an excellent state of preservation. Quartz is less abundant than the feldspar and the dark mineral is chiefly biotite with a little hornblende and minute grains of magnetite. Corrosion produces no appreciable change in colour.

The physical properties are:

Specific gravity	2.789
Weight per cubic foot, lbs	171.363
Pore space per cent	0.432
Ratio of absorption, per cent, one hour	0.133
" " " two hours	0.133
" " " slow immersion	0.133
" " " in vacuo	0.133
" " " under pressure	0.156
Coefficient of saturation, one hour	.853
" " " two hours	.853
" " " slow immersion	.853
" " " in vacuo	.853

Roberval granite. Bernier's quarry, Roberval, Que.

Plate XLx.



Roberval "Blue Granite." Bernier's quarry, Roberval, Que.

Crushing strength, lbs. per sq. in., dry	28,150
" " " " wet	23,100
" " " " wet after freezing	22,290
Transverse strength, lbs. per sq. in.	1,810
Shearing strength, lbs. per sq. in	1,305
Loss on corrosion	0.000
Drilling factor, mm.	5.7

Two horse derricks are installed. Work has been intermittent: at times 45 men are employed but only four were engaged at the time of my visit. The haul to the rail is about a mile. Stone from this quarry has been used in the church at St. Prime, the armouries in Quebec, and the Hotel de Ville in Roberval. The coursing stone in this latter building is the red variety and the trimmings are of the blue stone. The stringers of finer material referred to in the description of the quarry are scarcely apparent either in the rock-face or bush-hammered work.

OTTAWA AREA.

James Brodie and Son, Iberville, Que.; Robert Brodie, local manager, Bedard, Que.

This firm controls either in fee simple or by lease of quarrying rights, lots 4, 5, and 6, range A, township of Campbell, Ottawa county, and lot 2, range VI, township of Rochon, Ottawa county.

The quarry is opened in the side of a hill which rises probably 200 feet above the neighbouring valley. Stone is exposed for the upper 150 feet of this height. The present workings are situated about half way up the actual exposure, and have been extended for 150 feet on the west side of the mountain. The present face runs N. 10°W. and shows a maximum height of 20 feet. The preliminary work carried on in January, 1912, consisted of removing the stone at the south end of the workings in order to obtain a floor and a working face. This stone was rather thin and marred by flow structure and veinlets; it was worked up into paving blocks. Northward the stone becomes solid and presents four thick sheets in ascending order as follows: 2 ft. 6 in.; 7 ft.; 5 ft.; thin parting; 3 ft. The sheets dip 12° to the southwest, the rift is horizontal and the grain vertical exactly east and west magnetic. The main joints run a little east of north and dip 80° to the westward. The first of these joints is 40 feet in from the original face of the hill at the north end. The next joint is 4 feet in at the south end but it runs into the first joint at the north end. The third joint of this series is fully 20 feet farther to the e[illegible] few parallel cracks appear in the top sheet but they do not extend into the beds beneath. Cross joints are practically absent. The surface of the 7 foot bed which has been exposed by quarrying operations shows no sign of jointing over an area at least 20 feet square. Below the floor of the quarry the stone is exposed in almost vertical cliffs for a distance of 75 feet. It is disposed in heavy sheets without any sign of excessive jointing even on the exposed surface. Proceeding northward along the bottom of the cliff the stone seems to improve in quality becoming practically free of flow structure, knots or veinlets. The rock is all fine grained and of a light red colour for the most part (839), but in places it becomes almost grey. The stone in Rochon has not yet been worked. It differs from that at the quarry in showing a lighter colour, being grey with only a slight cast of pink. (Plate XX).

The stone: No. 839. This granite is of fine grain and light reddish colour. The polished surface is shown in Plate XXI. Under the microscope the stone shows clear quartz crystals which are usually not more than a millimetre in cross section.

The feldspar individuals are larger and more abundant with the microcline variety much in evidence. Black mica occurs in small amount and is associated with a few grains of magnetite. The feldspars are fairly fresh but some decomposition has set in. Oxidation has occurred in the mica with the production of a reddish stain which has invaded the neighbouring area No apparent change ensues on corrosion. The physical properties are:

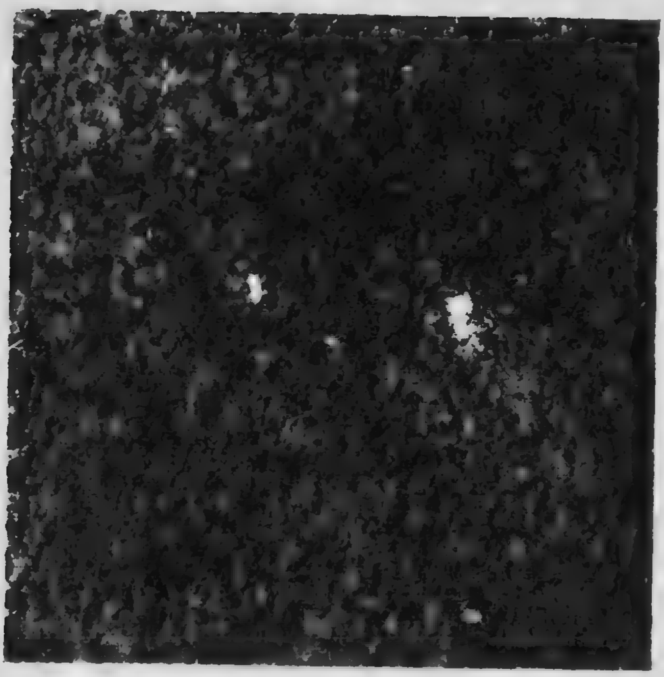
Specific gravity	2.665
Weight per cubic foot, lbs	165.274
Pore space, per cent	0.655
Ratio of absorption, per cent, one hour	0.162
" " " two hours	0.162
" " " slow immersion	0.2045
" " " in vacuo	0.227
" " " under pressure	0.247
Coefficient of saturation, one hour	.65
" " " two hours	.65
" " " slow immersion	.82
" " " in vacuo	89
Crushing strength, lbs. per sq. in., dry	33,100
" " " " wet	34,800.
" " " " wet after freezing	31,320.
Transverse strength, lbs. per sq. in	2,810.
Shearing strength, lbs. per sq. in	2,355.
Loss on corrosion, grams per sq. in	0.000959
Drilling factor, mm	2.8

The dry crushing strength is evidently too low and is to be explained by the fact that the test cube yielded on the side before the final collapse. It will be observed that the stone is of higher crushing strength and also of considerably higher shearing and transverse strength than the rocks from Roberval and Rivière à Pierre: this is probably due to the finer grain. The low drilling factor was rather unexpected as the stone does not seem proportionately hard to work.

PLATE XX.

Ottawa county granite. Brodie's quarry, near Campeau, Que

Plate XXI.



Red Granite. Brodie's quarry, Ottawa county, Que.

Large blocks are easily removed from the ledges by a single Knox hole rimmed and fired with black powder. As an evidence of the facility of splitting on the grain it may be stated that a line of 3 inch plug holes sufficed for the splitting of the 7 foot bed for a distance of 25 feet. In making paving blocks the stone is said to part very readily on both rift and grain and with but little less ease on the hardway.

A good road over fairly level country has been built to the railway, a distance of 2¾ miles. One ten-ton horse derrick is installed. Sixteen men were employed at the time of my visit, but it was the intention of the firm to increase the force. About 70,000 paving stones had been made by July, 1912. Four hundred tons of dimension blocks had been shipped to Iberville and a car load to Toronto for monumental purposes.

ARGENTEUIL AREA.

Laurentian Granite Company, Limited; Joseph Brunet, president; Joseph Lapointe, secretary, 224 St. James St., Montreal; John Columb, local manager, Roussillon, Que.

The company holds the following lots of 100 acres each in the county of Argenteuil:—Cadastral lots 764 and 765 and part of lot 766 in the seventh range of Chatham and part of lot 822 in the eighth range.

Two openings have been made on lots 764 and 765. The first quarry is about 400 feet long in a north and south direction and 300 feet wide. The depth is 20 feet at one end and 30 feet at the other; the maximum depth in the centre is about 60 feet as the crown of the hill has been quarried out. The second quarry extends about 500 feet along the east side of the hill, into which it has been carried a distance of 200 feet. The present face is 70 feet high, but an advance of about 300 feet more would give a face of fully 100 feet.

The sheets conform in a dome-like manner with the general configuration of the hill: they are not continuous but thin out to less than a foot or expand to 8 feet in thickness. The main joints run N. 15°E and dip eastwardly at from 65° to 80°. In the upper part of the quarry these joints vary from 1 to 10 feet in spacing but at the lower levels they are frequently 20 feet apart. The second set of joints is nearly at right angles to the first: the partings are from 5 to 15 feet apart at the top but in the lower levels they are separated by intervals as great as 60 feet. The rift is usually horizontal and independent of the sheeting but in places it appears to conform with the sheets. The grain is east and west, vertical.

The stone is of very uniform colour and grain but when polished a banded variation in colour is more perceptible. Occasional black knots and thin black streaks occur but they are not sufficiently numerous to prevent the extraction of clear stone in large blocks. The upper stone is too much fractured to work exclusively for dimension stone, but by using the smaller material for paving blocks and crushing the refuse, some stone of large dimensions can be obtained. The lower stone is less fractured and permits the extraction of blocks of very large size.

The stone: No. 619. A medium to coarse grained granite of a pinkish to light chocolate colour. The polished surface is shown in Plate XXIII. The stone is composed of large crystals of orthoclase, rather smaller crystals of quartz, and a still less amount of blackish-green mica. The feldspar crystals are considerably decomposed and have been invaded by reddish stains which have resulted from the decomposition of the mica or of some ferruginous minerals accompanying it. This stone is not as fresh as the rocks from Roberval and Rivière à Pierre.

The physical properties are as follows:

Specific gravity	2.651
Weight per cubic foot, lbs.	164.48
Pore space, per cent	0.613
Ratio of absorption, per cent, one hour	0.1466
" " " " " two hours	0.1466
" " " " " slow immersion	0.1659
" " " " " in vacuo	0.1858
" " " " " under pressure	0.232
Coefficient of saturation, one hour	.63
" " " two hours	.63
" " " slow immersion	.714
" " " in vacuo	.8
Crushing strength, lbs. per sq. in., dry	37,590.
" " " " " " wet	36,300.
" " " " " " wet after freezing	38,100.
Transverse strength, lbs. per sq. in.	2,810.
Shearing strength, lbs. per sq. in.	1,590.
Gain on corrosion, grams per sq. in.	0.000396
Drilling factor, mm.	4.1

Although the crushing strength tests are contradictory, they are so near together that it may safely be concluded that the stone is not measurably affected by water or frost under the conditions of the experiment.

The equipment of the company may be summarized under different heads as below: -

Quarrying plant.

Two 40 h.p. boilers supplying steam to
One Canadian Rand compressor and
One Ingersoll-Sargeant compressor,
Two hoisting engines,
Two 50 h.p. boilers and one 30 h.p. boiler supplying steam to
Three Canadian Rand drills and
Two hoisting engines (one double),
Five derricks (the extra derrick is operated from the double hoist).
Thirteen plug drills,

Two quarry bars.

Seventy-five quarrymen are employed.

To open up a new sheet the floor of the quarry is attacked in the following way. A channel is made by bar channelling through the sheet at a slight inclination to the grain. Channels are then run across the grain at each end of the long cut. The part of the floor attacked therefore presents a long narrow rectangle with one diagonal and two short ends cut. Holes about 20 feet apart are now sunk along the grain, i. e. along the sides of the rectangle. Each hole is charged with three pounds of black powder and tamped lightly, no air chamber being left. First one triangular piece and then the other is removed in this way. The channel cut along the grain now presents a working face. The natural joints are used as ends. The further procedure is as follows: If, for example, the joints are 8 feet apart three holes are sunk along the grain, six feet back from the face. The holes are charged with a pound of powder each and fired simultaneously by battery. This operation is repeated and is then followed by a heavier charge using about $2\frac{1}{2}$ lbs. in each hole. This series of discharges usually suffices to dislodge the block after which it is cut up by plug and feathers. Three-inch plug holes, six inches apart are found to serve for splitting stone two feet thick along the grain. To split on the rift an interval of 8 inches may be allowed but on the head the interval must not be greater than 4 inches.

Crushing plant:

One 125 h.p. boiler supplying steam to
One engine, operating
One Acme No. 14 crusher, and
One Acme No. $10\frac{1}{2}$ crusher.
One 60 h.p. boiler supplying steam to
One hoisting engine and
One compressor which supplies air to
Four plug drills.
Forty men are employed.

Paving stone plant:—

Paving blocks are made by piece work. The men supply their own hammers but the company furnishes drills. Working on plugged quarry blocks the men receive $24 per thousand, and on irregular quarry blocks $28 per thousand. Working on boulders the company does the drilling and blasting, paying the men $32 per thousand for the rest of the work.

Seventy men are employed.

Cut stone department:

The mill is 150 feet by 60 feet. It is supplied with the following equipment:—

One locomotive crane.

One 60 h.p. boiler,
One 40 h.p. engine,
One compressor,
One lathe,
Two surfacers (Kotten, N.Y.),
Pneumatic tools,
Forty stone cutters are employed.

General equipment:

Four and three-fifths miles of spur to C.P.R.
Four quarry cars,
Local tracks,
Offices, blacksmith shop, stables, etc.
Two engineers and eight labourers are employed.

Rough monumental blocks are valued at from 90 cents to $1 per cu. ft., f.o.b. quarry

Rough building blocks, 50 cents to 75 cents per cu. ft., f.o.b. quarry,
Paving blocks, $60 to $62 per 1000 in Montreal.

The production in 1910 was as follows:
Building stone, dressed, 1918 tons,
Monumental stone, rough, 172 tons,
Paving blocks, 4422 tons,
Rubble, 270 tons,
Crushed stone, 23,549 tons.

Paving blocks from this quarry have been shipped in large quantities to Montreal, Ottawa, Toronto, Three Rivers, and even to Cuba.

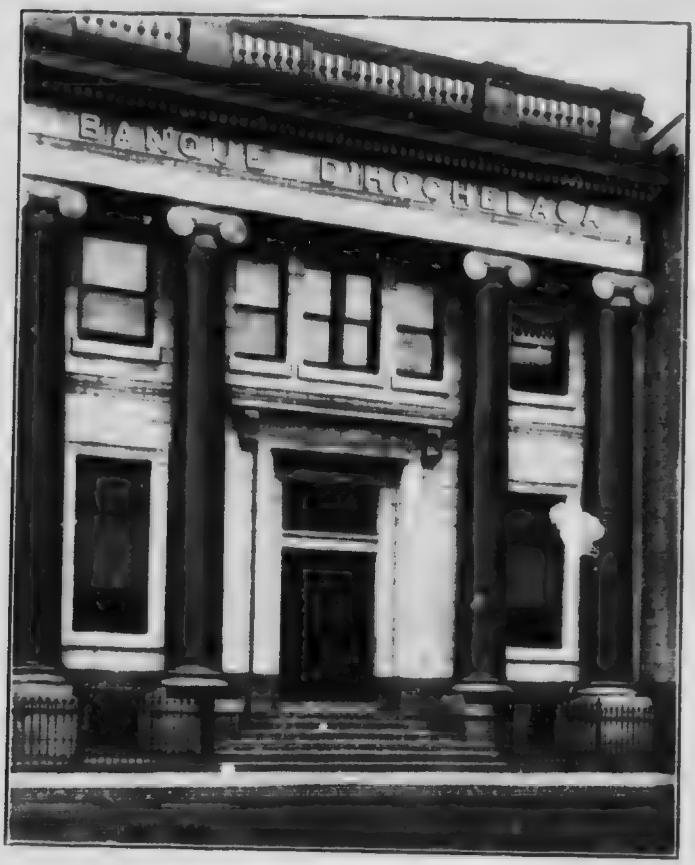
Good examples of the use of this stone for building may be seen in the following structures:

Bank of Hochelaga, Three Rivers (columns and trimmings, Plate XXII).
Montreal jail at Bordeaux.
Post-office at Westmount.
Court house at Sherbrooke (coursing stone and columns).

The rock-face work in the court house at Sherbrooke presents a dull brownish red aspect which contrasts well with the lighter trimmings of Stanstead granite. The columns are 15 feet long, of good uniform light brownish red colour.

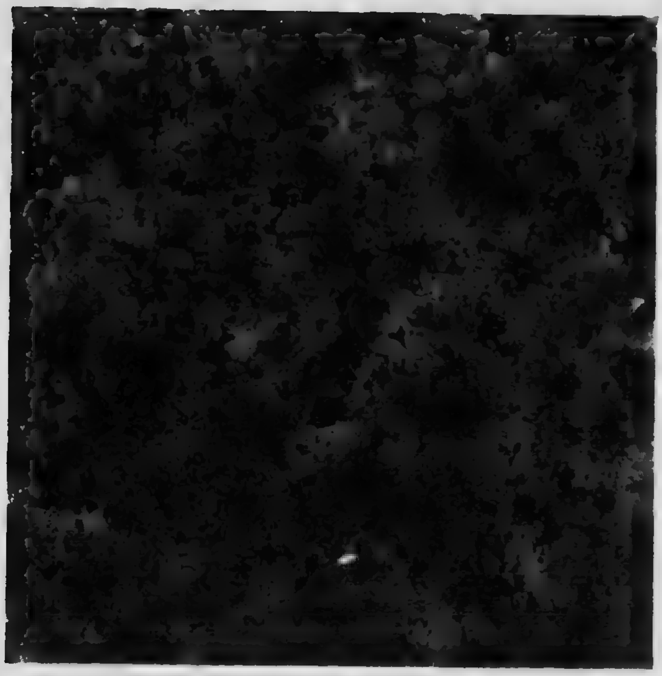
James Brodie and Son, Graniteville, Que. (Now Argenteuil Granite Co.).

This quarry is situated on the southern aspect of the same hill worked by the Laurentian company at their first quarry. The opening is about 400 feet long and is extended irregularly into the hill. The present face is nearly 100 feet high. The formational features are similar to those described for the Laurentian company. The quarry has not a vertical face of 100 feet as only the upper stone has been removed up the hill. The



Argenteuil granite. Hochelaga bank, Three Rivers, Que.

Plate XXIII.



Argenteuil Granite. Laurentian Granite Co., Staynerville, Que.

product was all converted into paving blocks of which 600,000 were made in 1911

One derrick, one steam drill, 14 quarrymen, 25 paving cutters.

The stone is the same as that in the other quarries and has been described as No. 619 on page 148.

Summary—Argenteuil Area.

A large granitic mass occurs in Chatham Grenville and adjoining townships in the county of Argenteuil. The important quarries are situated in the seventh range of Chatham and are connected by a spur of about 5 miles in length with the Canadian Pacific railway. Extensive operations have been carried on for many years resulting in a large production of building and monumental stone. More recently a large proportion of the output has been converted into paving blocks. The stone is a rather coarse grained granite with a peculiar pinkish to chocolate colour which is shown in Plate XXIII. The courthouse in Sherbrooke illustrates the use of this stone for coursing and that building as well as the Bank of Hochelaga in Three Rivers shows the suitability of the stone for the making of long columns. (Plate XXII). A detailed description of the stone is given on page 148.

Literature: Geol. Sur. Can., Rep. 1899, p. 138 J.

ST. JEROME AREA.

B. Germain, St. Jerome, Que.

The large hill about 1 mile northeast of St. Jerome contains an unlimited amount of gneiss. Quarrying operations of a very limited character have been carried on by M. Germain on a property of two acres in this vicinity.

The formation strikes due east and west and is cut by numerous joints of an irregular character, of which the most pronounced strike N. 60°E. These joints are never very far apart or very close together so that no difficulty should be experienced in extracting blocks of a size suitable for building. The stone is a reddish, well laminated gneiss described below as No. 615.

The stone: No. 615.—A medium to coarse grained well banded gneiss consisting of red feldspar, clear glassy quartz, black hornblende and a small amount of bright red garnet. The feldspar appears to be mostly orthoclase but some crystals of plagioclase occur. Under the microscope the hornblende is of bright green colour and fresh. The feldspars are but slightly decomposed: there is rather more of the soda-lime variety than would be expected from an examination of the broken surface.

Joseph Cyr, St. Canut, Que.

About 1 mile north of St. Canut, Mr. Cyr has opened quarries in the great ridge of gneiss which forms the border of the Laurentian oldland.

At this point the stone is exposed over several acres and has been quarried to an inconsiderable depth at a number of places.

The rock is a gneissoid granite in which the lamination is much more pronounced in some places than in others. The general direction of the lamination is N. 10°E. The sheeting is not pronounced but it appears to dip at a low and varying angle to the west. The major joints run with the strike and are widely spaced. Cross joints cut the formation at right angles to the above: these are generally too closely set to permit the extraction of large blocks without flaws. Towards the north of the property this objectionable feature is less pronounced. As already stated the stone varies greatly in the development of gneissoid structure. The more granitic type is described as No. 617 and the more gneissoid type as No. 618. All gradations are to be found between these two extremes.

The stone:—No. 617.—A medium to fine grained light reddish granite resembling No. 839 but presenting a coarser grain than that stone. In small specimens the structure is granitic but in larger pieces evidence of gneissoid structure is observable. The rock is composed of pinkish orthoclase, white quartz and a small amount of black hornblende in small crystals. The corrosion test produces no perceptible change.

The physical properties are:

Specific gravity	2.641
Weight per cubic foot, lbs	164.171
Pore space, per cent	0.422
Ratio of absorption, per cent, one hour	0.1233
" " " two hours	0.1335
" " " slow immersion	0.1345
" " " in vacuo	0.1452
" " " under pressure	0.162
Coefficient of saturation, one hour	.763
" " " two hours	.823
" " " slow immersion	.84
" " " in vacuo	.907
Crushing strength, lbs. per sq. in., dry	39,000.
" " " " wet	39,000.
" " " " wet after freezing	29,360.
Gain on corrosion, grams per sq. in.	0.000296

The crushing strength test of the frozen specimen was not satisfactory as the cube began to fail from one side: in such cases the results are always much too low.

No. 618.—This stone resembles the above in its general characteristics but presents a more gneissoid structure with dark thin bands of hornblende and quartz running through the granitic mass. In places these bands become wide and constitute interlaminated hornblende schist.

The gneissoid character of most of the stone renders it unsuitable to purposes of fine construction but it is said to split with facility and in con-

Cedar
LAKE MEMPHREMAGOG

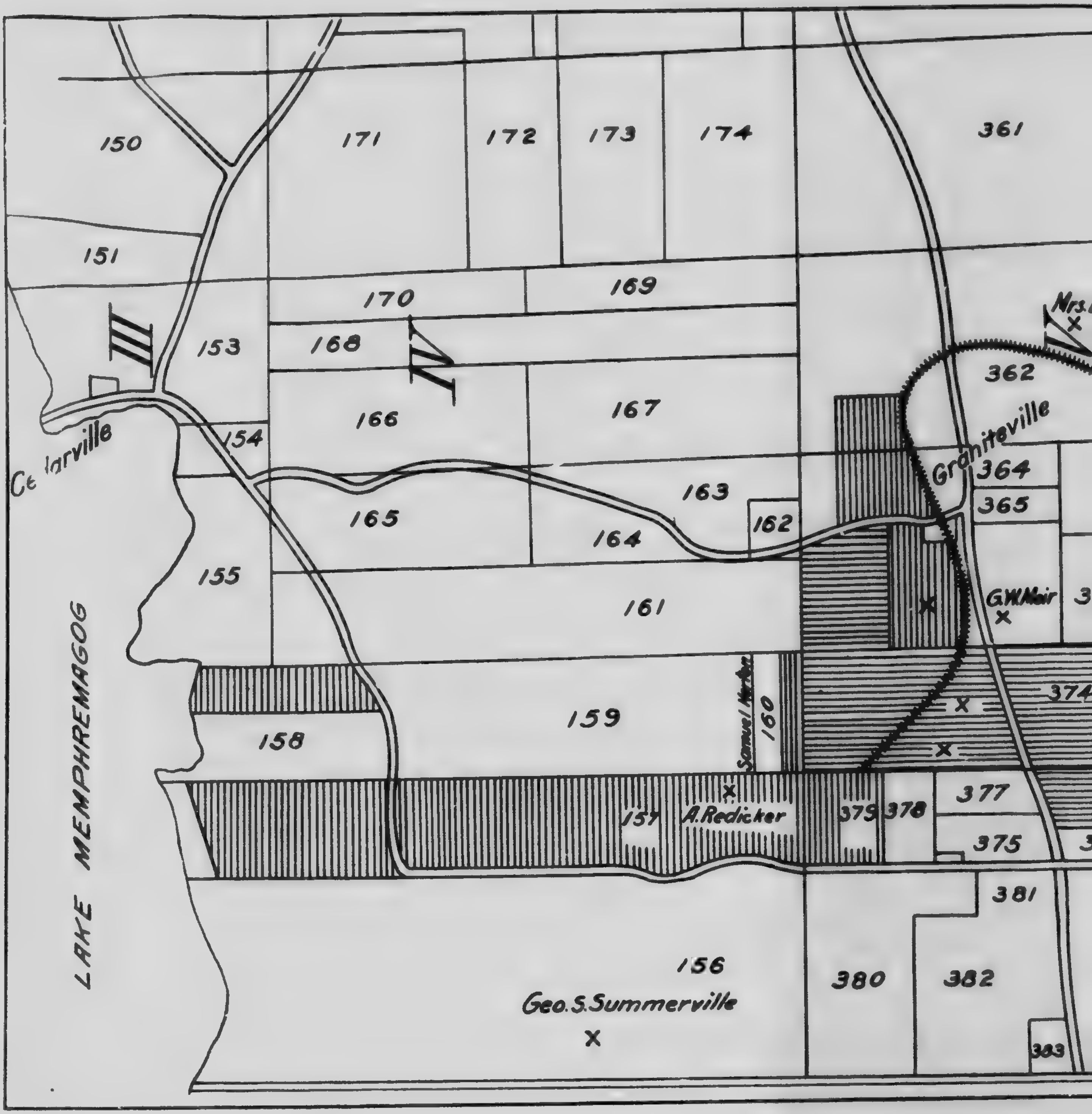
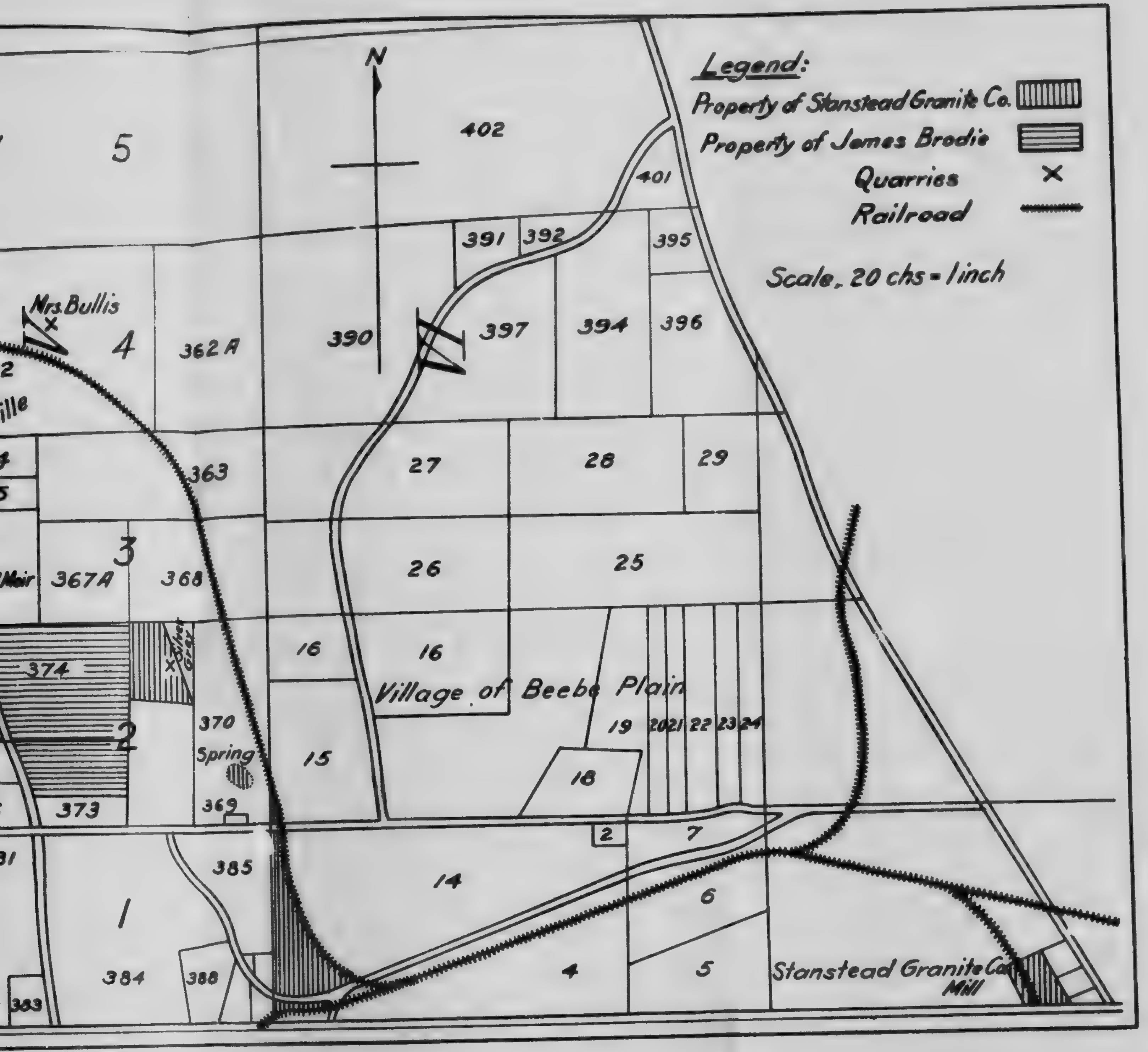


Fig. 6.—Sketch map of the quarry district at



district at Stanstead, Que., showing the location of the chief quarries.

sequence to be well adapted to the making of paving blocks, for which purpose it has been used. During the last few years about 100,000 blocks a year have been shipped to Montreal and Quebec. At the time of my visit the quarry was idle. The equipment consists of one steam drill and a derrick with steam hoist.

In connexion with the northern Pre-Cambrian region the following notes may be of interest:—

The great syenitic mass of Rigaud mountain in Vaudreuil presents a granite very similar to that of Argenteuil. Ells states that a quarry was opened on the east spur of Rigaud mountain, from which large blocks for monumental work were obtained.[1]

It is also stated that a quarry was opened for road metal in a dark coloured granitic rock one mile south of Wakefield station on the Gatineau Valley railway.

The large mass of granite reaching across Berthier and Maskinongé counties into the county of St. Maurice presents possibilities of production but I am not aware of any systematic quarrying having been attempted for building purposes, although the stone is used locally for road metal, etc.

Granite of the Eastern Townships.

An interesting account of the geology of the granitic intrusions of the Eastern Townships is given by Ells in the Report of the Geological Survey of Canada for 1886 and also in his report on the mineral resources of the Province of Quebec contained in the volume for 1888-89.

STANSTEAD AREA.

The Stanstead intrusive lies on the east side of Lake Memphremagog near the international border. The belt of good stone stretches in a northeast and southwest direction with a width of about a mile and a half. The most desirable stone is along the northwest margin of the outcrop and here the principal quarries are located. The companies or individuals engaged in the industry at the time of my visit were as follows:—

Stanstead Granite Quarri[illegible]o., Ltd.
Samuel B. Norton,
James Brodie,
G. W. Moir,
Geo. S. Sommerville,
Russell Redicker,
Mrs. Bullis,
Charles Haselton.

Stanstead Granite Quarries Co., Limited, W. R. Brock, president, Toronto; John McIntosh, vice president and managing director, Beebe Plain, Que.

The company controls the following properties:—

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[1] Geol. Sur. Can., Report 1899, p. 136 J.

Part of cadastral lots, 367, 366, 158, 157, 362, Stanstead; lot 379, Stanstead; lots 1 and 54 and part of lot 14, Beebe Plain; also railway right of way on lots 367, 366, 362, 363, 368, 367, 374, 370, Stanstead, and lot 14, Beebe Plain; rights to the spring on lot 370, Stanstead.

This company began operations in 1899—the property was first worked 30 years ago. The quarry is about 700 feet long in a direction 30° east of north: the width is almost as great and the maximum depth is 50 feet. The sheeting is somewhat irregular but the following fairly well marked divisions are to be observed in descending order—3½, 6, 8, 7, 10, 14 ft. All these sheets are solid and without conspicuous flaws. A strong joint strikes E. 10° N. and dips 60° to the northward. On the north side of this joint the sheets dip at varying angles (about 20°) to the northwest: south of the big joint they dip more to the westward. A few blind joints occur, one striking W. 10° N. and dipping 60° northward. The rift is horizontal and the grain vertical in a direction W. 32° S. Wavy horizontal veinlets occur in some parts of the upper sheet and occasional narrow dykes of fine grained material accompanied by veinlets cross the formation in a north and south direction. Small black knots containing pyrites are rather frequent in parts of the quarry, particularly near the big joint. The pyrite is said to exhibit very little tendency to oxidize and run.

The stone: No. 745.—The stone from these quarries is essentially the same as Nos. 743 and 744 which are described in detail on pages 156 and 158, and are represented in Plate XXVII.

The quarry is worked down the dip as far as possible, the stone being dislodged by Lewis holes fired with successive charges of powder. It is stated that one Lewis hole, 35 feet from the face broke off a block of stone 300 feet long in one solid piece. Plug holes 6 inches apart along the rift will break stone 6 feet thick. Some very large blocks have been obtained from this quarry; for instance, it is not unusual to obtain columns 20 to 25 feet in length. Probably the largest stones shipped from these quarries were used in the construction of the vault for Senator [illegible]k in Toronto, in which are seen seven columns, 34 feet long, by 3 ft. 4 in. [illegible] 1 ft. 8 in. Some blocks 12 ft. by 12 ft. were shipped for use in the Côte des Neiges cemetery in Montreal.

The quarry equipment consists of 20 derricks, 2 steam hoists of 25 tons capacity each, 12 drills on direct steam and one large quarry bar. Fifteen men were working at the time of my visit but the force is sometimes increased to 40 men.

The mill is of concrete and steel, 290 ft. by 120 ft., with a detached engine house of brick, 85 ft. by 40 ft., and a boiler room, 25 ft. by 20 ft. Between the engine room and the mill is an annex, 40 ft. by 50 ft. The engine plant is auxiliary only, and is equipped with a 125 h.p. Corliss compound engine and a 40 h.p. air compressor. Steam is generated by two 165 h.p. boilers. Under ordinary circumstances the plant is operated by electric power which is obtained from the Sherbrooke Railway and Power

Co. About 125 h.p. is used continuously. The following table shows roughly the distribution of the power and the general nature of the equipment:

Motor, 60 h.p.; 550 volts; 62 amperes; direct current Almanna Svenska Elektriska, A.B., Sweden.

Gray-Blaisdell compound compressor delivering air at 80 lbs. per sq. in. to surfacers and pneumatic tools

Motor, 40 h.p

Two gangsaws, Geo. Anderson, Carnoustie, Scotland.	Two polishers, Patch Manufacturing Co., Rutland, Vt.	One pendulum polisher

Motor, 10 h.p.

One cutting lathe	One polishing lathe

Motor, 10 h.p. One planer, Brunton and Trier, London.

Motor, 5 h.p. Grindstone.

Four motors, 10 h.p.—On two travelling cranes, Lane Manufacturing Co., Montpelier, Vt.

The gang saws are usually operated with two or three blades using chilled shot: their efficiency is about 2½ inches per hour on stone 10 feet long. The blades are made with an interrupted cutting edge, pieces 2½ inches long being cut out at intervals of 4 inches. The toothed portion of the blade is ⅜ in. thick and the upper part ¼ in. thick (Plate XXVI).

The average annual output is 40,000 cubic feet. The average value of dressed stone is $3.50 per cubic foot. Eighty men are employed in the mill. Rough blocks are quoted at 40 cents per cubic foot, f.o.b. quarry siding.

Among the many important buildings constructed of stone from these quarries may be mentioned:

Bank of Commerce, Montreal.
Eastern Townships Bank, Montreal.
Canadian Pacific Railway offices, Toronto.
Post-office F, Yonge St., Toronto.
Lumsden building, Toronto.
Bank of Commerce, Winnipeg.
Eastern Townships Bank, Winnipeg.
National Trust Company's building, Edmonton.
Royal Bank, Edmonton.
Molson's Bank, Calgary.
Canadian Pacific Railway station, Calgary.

Parliament Buildings, Regina
University Buildings, Saskatoon.

Samuel B. Norton, Beebe Junction, Que.; Part of Lot 2, Con. IV, Stanstead

This property adjoins that of the Stanstead Company and consists of six or seven acres on which is an excavation about 400 feet by 300 feet and 30 feet deep. The beds are heavy—up to 10 feet thick—and dip at a low angle to the southwest. The sheeting planes are somewhat undulatory but for practical purposes they may be regarded as almost flat. The rift is horizontal and the grain vertical in a direction 20° north of east. The jointing is shown only by two partings 50 feet apart and striking W. 20°N. with a vertical dip. The favourable jointing and the pronounced rift and grain greatly facilitate the removal of stone from the ledges, as may be seen from the following example. (Plate XXIV).

At the [illegible] Mr. Norton desired to break the 10 foot bed on the hardway 30 feet back from the face. The block was practically free at both ends and [illegible]. A four hole Lewis was sunk to a depth of 9 feet, the cores were cleaned out and the hole was loaded with about a quart of coarse black powder. A ten inch air chamber was left and the remainder of the hole was tamped hard with dry sand. On firing, a crack resulted of sufficient width to permit the introduction of about four quarts of powder which was tamped down with dry sand as before. The firing of this charge sufficed to dislodge the block with a straight and even fracture.

The stone: No. 744.—The stone from the different quarries in the immediate neighbourhood of Graniteville does not differ essentially in colour or structure. Plate XXVII will serve to illustrate the appearance of the polished surface of any of these stones.

The chief constituent is orthoclase feldspar with which is associated a considerable amount of plagioclase. Quartz is present in less amount and black mica is scattered throughout in small flakes. The feldspar crystals are fresh for the most part but some individuals show considerable alteration. The corrosion test produces no observable effect.

The physical properties are as follows:

Specific gravity	2.683
Weight per cubic foot, lbs.	166.215
Pore space, per cent	0.861
Ratio of absorption, per cent, one hour	0.2159
" " " two hours	0.2285
" " " slow immersion	0.2785
" " " in vacuo	0.286
" " " under pressure	0.33
Coefficient of saturation, one hour	.65
" " " two hours	.69
" " " slow immersion	.82
" " " in vacuo	.86

Stanstead granite. Norton's quarry, Graniteville, Que.

Crushing strength, lbs. per sq. in., dry	23,770
" " " " wet	21,100
" " " " wet after freezing	21,850
Transverse strength, lbs. per sq. in	2,192
Shearing strength, lbs. per sq. in	1,570
Loss on corrosion, grams per sq. in	0.00128
Drilling factor, mm	6.7

The wet crushing test is evidently too low; the cube failed from one side.

The equipment consists of one steam derrick of ten tons capacity, two horse derricks, one hand derrick and minor appliances.

The average production of building stone has been 30,000 cubic feet per year for the past few years. The production of paving blocks varies from 200,000 to 400,000 per year.

Mr. Norton employs 50 men including paving cutters.

The following prices are quoted, all f.o.b. cars at quarry:

Monumental dimension stock.

Blocks up to 40 cubic feet	45 cents per cubic foot.
" 50 "	50 " " "
" 60 "	55 " " "
" 70 "	62 " " "
" 80 "	70 " " "
" over 80 "	Special prices

Steps and platforms not exceeding ten feet in length.

Up to 24 inches wide	35 cents per superficial foot.
" 36 "	40 " " "
" 48 "	55 " " "
" 60 "	70 " " "
Over 80 "	Special prices.

Posts.

6 to 8 inches square	20 cents per lineal foot.
Over 8 in. and less than 1 ft. square	27 " " "

Bottom bases finished.

6 cut sides, with 8 cut wash	85 cents per cubic foot.
8 cut sides with 10 cut wash	90 " " "

Rock face with margin around top and down corners, 60 cents per cu. ft.

Rock face with margin around top only, corners chipped to line, 55 cents per cubic foot.

Rock face with wash cut sides chipped to line, 50 cents per cubic ft.

Building stock—40 cents per cubic foot.

James Brodie, Graniteville, Que.;Part of Lot 2, Range V; Part of Lot 3, Range V Stanstead; and other smaller sections.

Mr. Brodie operates two quarries separated by an interval of about 100 yards. The formation presents similar characteristics in the two openings but some differences are to be observed as shown in the following descriptions:—

The south quarry—This opening is 200 feet square with a maximum depth of 25 feet. The sheets undulate and vary in thickness but four rather distinct partings occur at intervals of 6, 6, 3, and 7 feet in descending order. The dip is N. 70°W. at a low angle. The more prominent set of joints runs due north and south at intervals of 20 to 25 feet. Less distinct joints traverse the formation, N. 50°W. in some parts of the quarry: elsewhere joints appear, E. 10°N. and N. 20°W. Most of these joints are clean and vertical and are not close enough together to cause serious trouble. The rift is horizontal and the grain vertical in a direction W. 22°S. Wavy blind joints are more troublesome than the jointing proper. These blind joints run straight across the grain: in the middle of the quarry they vary from 18 inches to 3 feet apart but towards the edges there may be an interval as great as 20 feet between them.

The north quarry—This opening is 300 feet long in a north and south direction and about 200 feet wide. The formation dips N. 70°W. at a low angle and is divided into undulating sheets at intervals of 3, 3, 2, 4, and 6 feet in descending order.

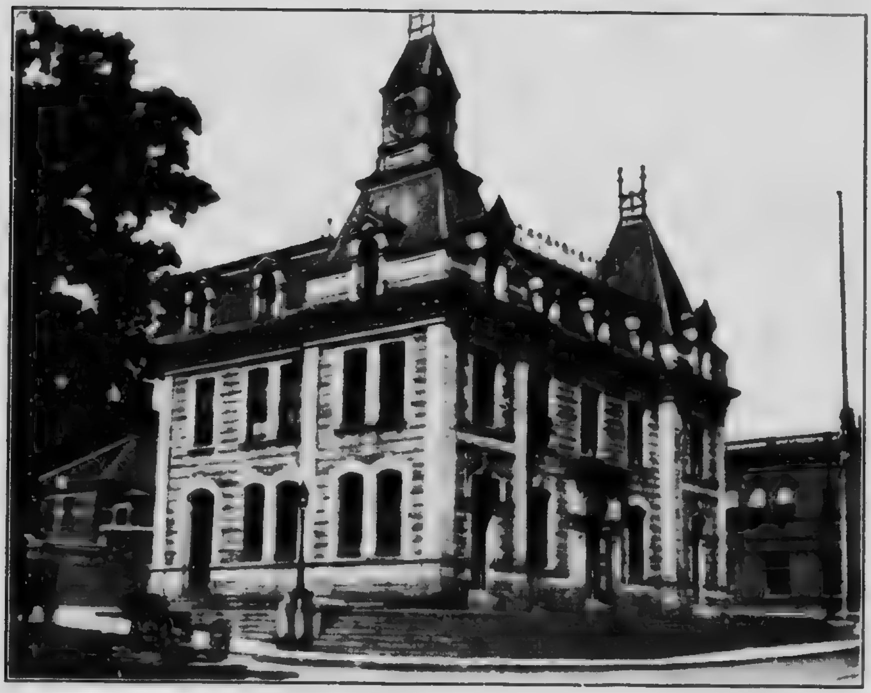
The rift and grain are as in the south quarry but the blind joints run due east and west and therefore cut the grain at a low angle instead of being normal to it as in the south quarry. Only two of these blind joints have been observed in this quarry. Visible joints are infrequent on the west side; one joint runs N. 20°W. but it is not accompanied by a parallel series. Near the south side of the quarry two parallel joints about 30 feet apart strike N. 40°E. It is obvious therefore that stone of any reasonable dimensions can be quarried without excessive waste.

The stone:—No. 743.—This stone is essentially the same as No. 744. See page 156 and Plate XXVII.

The physical properties are given below:—

Specific gravity	2.688
Weight per cubic foot, lbs	166.662
Pore space, per cent	0.738
Ratio of absorption, per cent, one hour	0.1812
“ “ “ two hours	0.1812
“ “ “ slow immersion	0.2175
“ “ “ in vacuo	0.2265
“ “ “ under pressure	0.277
Coefficient of saturation, one hour	.65
“ “ “ two hours	.65
“ “ “ slow immersion	.78
“ “ “ in vacuo	.81

PLATE XXV



Stanstead granite. Post-office, Sherbrooke, Que.

Crushing strength, lbs. per sq. in.,	dry	24,900.
" " " "	wet	22,450.
" " " "	wet after freezing	22,450
Transverse strength, lbs. per sq. in.		1,734.
Shearing strength, lbs. per sq. in.		1,475.
Loss on corrosion, grams per sq. in.		0.000804
Drilling factor, mm.		6.8

Mr. Brodie's method of opening a new floor is to channel three sides of a block about 20 feet square. The third channel is run at a slight angle so that the unchannelled side is a little shorter than the side opposite. The block is then dislodged by Lewis holes on the short side which may coincide either with the head or the grain. Mr. Brodie informed the writer that in splitting the stone on the rift it is better to put the plug holes on the face of the block representing the head or hardway rather than on the face produced by splitting on the grain. In splitting on the grain it is found better to put the plug holes on the horizontal surface in summer. On the other hand, when the stone is frozen, it parts on the grain with greater facility if the plug holes are put on the surface representing the hardway.

In the south quarry the equipment consists of one 20 ton derrick with steam hoist and one large quarry bar (Rand).

In the north quarry the equipment is:

Two 20 ton derricks,
One 30 h.p. steam hoist,
One 20 h.p. steam hoist,
One Sullivan air compressor for plug drilling,
One small quarry bar and two tripod drills.

Mr. Brodie employs 22 men on daily wages and 14 paving cutters on piece work. Quarrymen receive $2.25 per nine hour day and labourers from 17½ to 20 cents per hour. Paving cutters receive 2¼ cents per block (4 in. × 5 in. × 8 in. — 13 in.). The total production in 1911 was 16,000 cubic feet of building and monumental stone and about 1,[illegible],000 paving blocks of which 700,000 were shipped to Montreal and 300,[illegible] to Quebec.

The following prices are quoted, all f.o.b. quarry siding:

Paving blocks, $40 per 1,000.

Building stone, 40 cents per cubic foot.

Monumental stone, 45 cents per cubic foot up to 40 cubic feet; larger sizes higher.

Stone from these quarries may be seen in the following structures:—

Bank of Commerce, Montreal.
Bank of Montreal, Montreal (part only).
Eastern Townships Bank, Montreal.
Grand Trunk Railway building, McGill street, Montreal.
Royal Trust building, Montreal.

G. W. Moir, Graniteville, Que.

Mr. Moir holds ten acres in lot 3, range IV, Stanstead, adjoining the property of the Stanstead Co. and James Brodie. The opening is about 150 feet square with a depth of 6 or 8 feet. The sheeting is not thick as 2 feet was the maximum observed. One clean vertical joint crosses the formation, W. 10°N. Towards the east the stone shows considerable lamination but on the whole it is essentially the same as in the adjoining quarries. A derrick is installed but no work was in progress at the time of my visit. Mr. Moir also controls a quarry on lot 3, range III, Stanstead, which produces the silver grey type described below as No. 749.

The stone: No. 749[1].—This example differs so little from Nos. 743 or 744 that it is difficult to describe; it is shown in Plate 52, No. 1. There seems to be a little less black mica and certain of the feldspar crystals are larger—as much as 8 or 10 mm. in diameter—which gives the polished surface a more distinctly spotted effect. The microscopic structure is the same as in Nos. 743 and 744. The feldspars are in about the same state of decomposition. The only difference observed was in the presence of a very few small crystals of augite associated with the black mica. The physical properties as given below are also very similar to the other examples.

Specific gravity	2.692
Weight per cubic foot, lbs	166.778
Pore space, per cent	0.758
Ratio of absorption, per cent, one hour	0.177
“ “ “ two hours	0.208
“ “ “ slow immersion	0.231
“ “ “ in vacuo	0.252
“ “ “ under pressure	0.2845
Coefficient of saturation, one hour	.62
“ “ “ two hours	.73
“ “ “ slow immersion	.81
“ “ “ in vacuo	.88
Crushing strength, lbs. per sq. in., dry	27,080.
“ “ “ “ wet	21,800.
“ “ “ “ wet after freezing	22,100.
Transverse strength, lbs. per sq. in	1,360.
“ “ “ “	1,230.
Loss on corrosion, grams per sq. in	0.000648
Drilling factor, mm	7.6

The wet crushing test is again too low, in this case there was no apparent reason for this anomaly.

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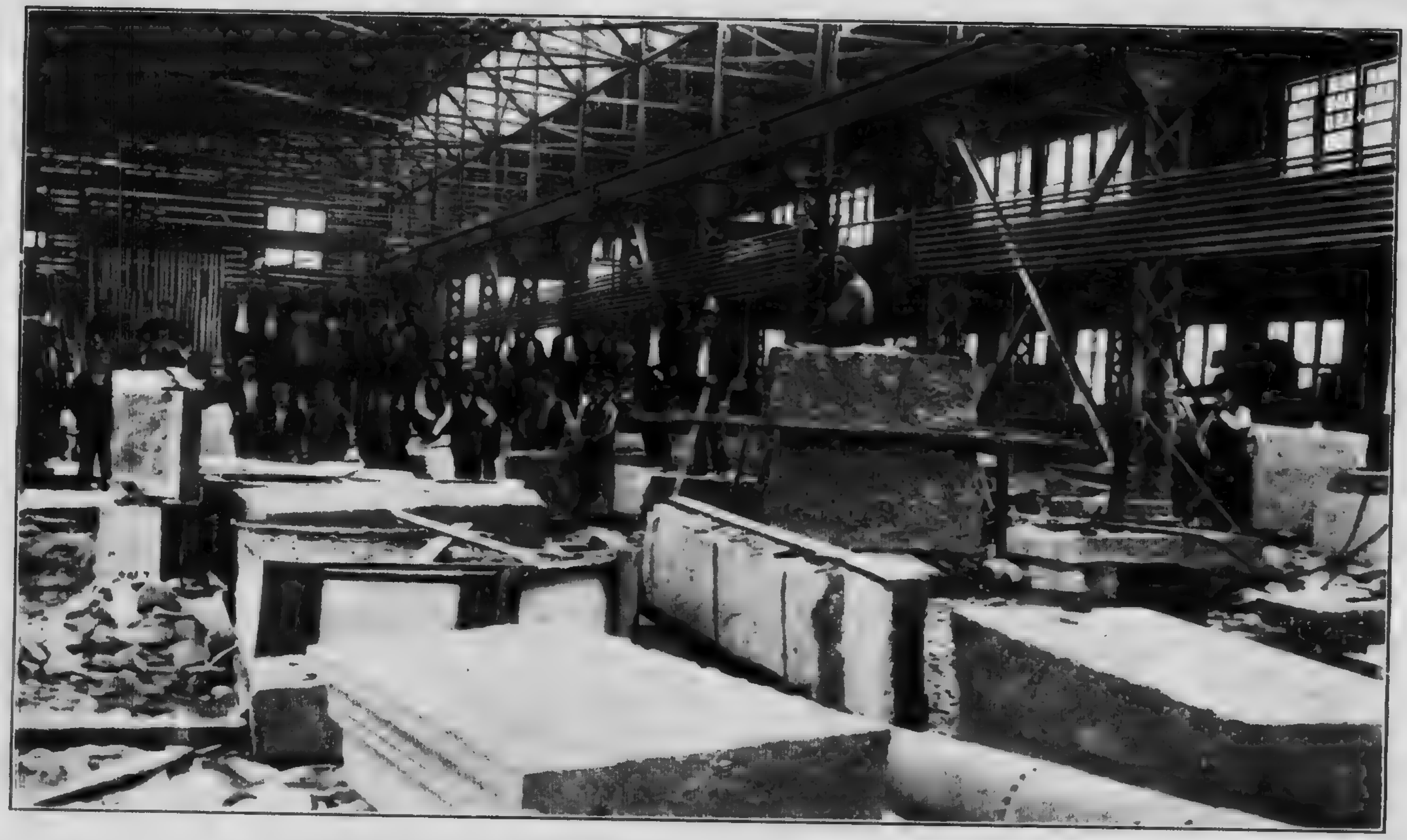
[1] This sample was obtained at a mill in Beebe junction: it was represented as typical "silver grey" but I now have reason to doubt the accuracy of the statement. For a more typical "silver grey" see No. 748, page 162.

PLATE XXVI.



Stanstead granite. Interior of the Stanstead Granite Company's mill, Beebe Plain, Que.

Geo. S. Sommerville, North Digby, Vt.

Mr. Sommerville holds quarrying rights on lot 1, range IV of Stanstead, which belongs to Geo. Brodie. The opening has been made near the west line of the lot about 30 rods north of the international boundary. The excavation is about 200 feet square and has been opened in the side of a minor elevation. The maximum depth is 19 feet. The sheets dip W. 30°N. at about 18°. The upper layer, the only one quarried, is 19 feet thick, but it is divided into thinner material by discontinuous horizontal cracks. Pronounced joints cut the formation vertically, W. 30°S. Another series runs N. 40° E. with a dip of 60° to the northwest, but neither series is so frequent as to prevent the quarrying of large blocks. At the south end of the quarry the rock seems to have faulted on a plane striking E. 10°N. and dipping 45° to the southward. At the north end there is a parting which strikes E. 10°S. and dips 45° to the southward. On the whole the formation is so badly cut up that although large stone can be obtained, its production entails a great amount of waste. The rift is horizontal and the grain vertical in a direction 35° degrees north of east.

The stone: No. 740.—This example resembles those already described in a general way. The grain is a little coarser and the quartz crystals have a tinge of colour which detracts somewhat from the clean appearance of the stone. The microscope shows large orthoclase crystals with incipient decay, a considerable amount of plagioclase, quartz and black mica: the latter mineral is fresher than in most of the Stanstead granites.

Mr. Sommerville has been working at this point for about five years; he employs four men and produces about 6,000 cubic feet a year which is largely disposed of for monument bases in Ohio and Iowa. The stone has also been shipped to Montreal, Toronto, Hamilton, and Brampton. The haul to the rail is about one mile.

Russell Redicker, Graniteville, Que.

Mr. Redicker has opened a small quarry on the property of the Stanstead Co. at a point about 100 yards southwest of Norton's quarry. The stone here is cut by rather numerous blind joints striking north and south and dipping 70° degrees to the east. Joints also cross the formation E. 20°N. with a dip of 60° to the southward. About 600 cubic feet of squared building stone was produced in 1911. Operations have been suspended.

The stone is the same as that of Norton's quarry and apparently has very few black knots.

Mrs. Bullis, Graniteville, Que.

A few monument bases of the average stone were obtained from this property on lot 4, range V of Stanstead.

Towards the east side of lot 2, range V, and close to the railway, is the now abandoned quarry in the silver grey type of stone. The quarry is opened in the side of a hill facing the east and has reached a maximum depth of about 25 feet. The sheets dip west at a low angle but they vary from west to W. 30°N. The upper sheet of 10 feet in thickness seems to be cut by many irregular horizontal partings but the lower stone is apparently more solid. The main joints strike east and west but vary to south of west. The dip is vertical or at a high angle to the northward. Less numerous joints strike N. 10°W. and dip 70° to the eastward.

The stone presents scattered black knots and wavy structural lines in places. Thin dykes of a dark basic rock cut the formation vertically in a direction 40° east of north.

The stone: No. 742. This variety of Stanstead granite as seen in the hand specimen is slightly darker with more black mica than in the typical stone from nearer Graniteville. The general structural features of the formation are less encouraging than the quality of the stone.

Another quarry (the old Stanstead quarry) is situated near the road in lot 2, range IV. The opening is about 200 feet by 50 feet with a depth of 15 feet at one end. The stone is less uniform than in the quarries now being worked and shows bands and blotches of lighter colour also some dark streaks; in some places the stone has a reddish aspect.

The stone: No. 741.—This stone is very like No. 742: it differs in showing some larger (porphyritic) feldspar crystals scattered through the general mass. The average stone seems to be of slightly finer grain and darker colour than the stone from the big quarries.

Charles Haselton, Beebe Junction, Que.

This quarry is situated about one mile from Beebe junction, on the road to Georgeville. The opening is about 100 feet by 50 feet. The upper bed only has been quarried: this sheet is solid and about 6 feet thick at the west end but thinner at the east. The dip is S. 20°E. at about 10 degrees. Joints run N. 30°W. vertical, and W. 10°N. with a dip of 80° to the south. These joints are clean and straight at intervals of 10 or more feet. Black knots and dark micaceous streaks occur but they are not so frequent as to prevent large stone being obtained. The product of this quarry is classed as silver grey: it was formerly largely used for monument bases.

The stone: No. 748.—This stone differs from the typical Stanstead stone in showing a rather coarser structure and considerably less black mica. The general effect is much lighter and the mica individuals appear as spots in a white ground rather than as a part of an intimate mixture with the other minerals. This stone differs more from the ordinary Stanstead granite than does the specimen from Moir's quarry described as "silver grey" under the Number 749 on page 160.

Summary—Stanstead Area.

The belt of granite which lies close to the international boundary near Lake Memphremagog in Stanstead township is the most important producer of granite for building purposes in the Dominion of Canada.

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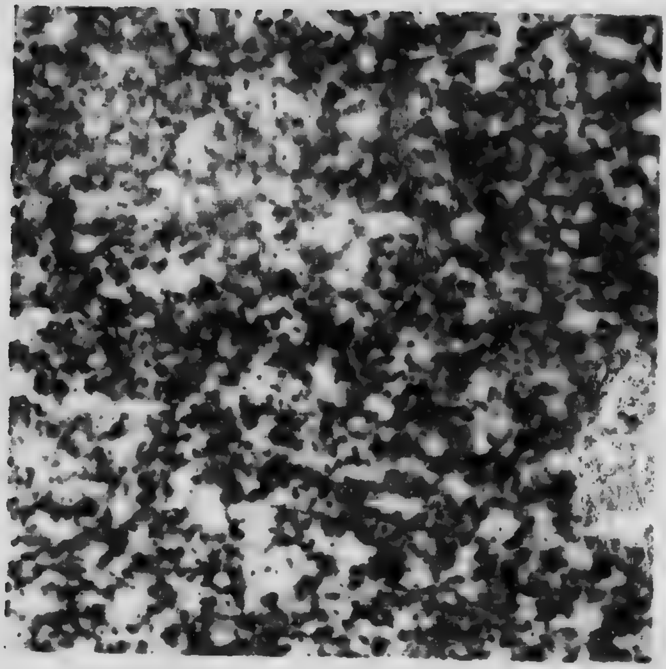
Plate XXXII



Stanstead Granite. Norton's quarry, Stanstead, Que.

The formation owes its value to the excellent sheeting and the pronounced rift and grain which render quarrying operations comparatively easy. (Plate XXIV). The more important stone and the only one now being quarried is a medium grained grey granite which is shown in Plate XXVII. Another variety known as "silver grey" which is a lighter coloured stone was formerly quarried and used chiefly for monument bases but there is no production of this type at present. The following list of physical properties represents the average of three samples from different quarries and may be regarded as typical of the Stanstead granite in general:

Specific gravity	2.687
Weight per cubic foot, lbs.	166.552
Pore space, per cent	0.789
Ratio of absorption, per cent, one hour	0.1913
" " " two hours	0.2059
" " " slow immersion	0.2423
" " " in vacuo	0.2548
" " " under pressure	0.2972
Coéfficient of saturation, one hour	.64
" " " two hours	.69
" " " slow immersion	.80
" " " in vacuo	.85
Crushing strength, lbs. per sq. in., dry	25,250
" " " " wet	25,116
" " " " wet after freezing	22,133
Transverse strength, lbs. per sq. in	1,762.
Shearing strength, lbs. per sq. in	1,425.
Loss on corrosion, grams per sq. in.	0.00091
Drilling factor, mm	7

It will be seen from the above list that Stanstead stone is considerably lighter in weight than limestone and that its pore space is rather high for this class of stone. The frost resisting properties as expressed in the coefficient of saturation are satisfactory. The crushing strength is not high for a granite and the transverse and shearing strengths are rather low. The wet specimens seem to suffer little loss in strength but there is an appreciable loss on freezing. The drilling factor is high for a granite and the stone should be capable of being carved with facility.

The total production for building and monumental purposes is about 95,000 cubic feet per year. In addition to this large production of building stone nearly 2,000,000 paving blocks are made every year.

Stanstead stone has been used in a great number of buildings in Montreal, Toronto, Ottawa, Quebec, Sherbrooke, and also in the western cities of Edmonton, Regina, and Calgary. (Plate XXV).

MAGOONS POINT AREA.

G. F. Greenwood, Montreal.

A large mass of granite occurs at Magoons Point on Lake Memphremagog and occupies the shore for a distance of half a mile to the northward of Bay View point. Inland the granite rises into a considerable hill and presents zones which are much fractured as well as areas in which quarrying might be easily done. A small amount of stone was quarried here in 1878 and was used in the construction of a dam at Magog. Mr. Greenwood controls about 400 acres.

The stone (where quarried) appears in the form of a hogsback striking E. 20°N. with a dip of 50° to the southeast but with a more gradual slant in the opposite direction. The sheeting seems to dip to the southeast at about 20°. The more abrupt side of the hogsback has probably been caused by jointing. Other joints cross the formation at S.50°E. and this series becomes excessive towards the west side of the property where the stone is much fractured. Towards the south, however, there is little doubt that stone of large size could be easily quarried and loaded into scows on the lake.

The stone: No. 746. This is a grey granite closely resembling the Stanstead stone in both colour and structure. Under the microscope the feldspars are seen to be rather more decomposed but it must be remembered that surface material only was procurable.

MEGANTIC AREA.

Granite has been quarried on the shore of Lake Megantic and at several points on the east flank of Little Megantic mountain near the line of the Quebec Central railway.

The chief operators are, or have been:

G. Fournier, Megantic.
Lacombe and D'Allaire, St. Sebastien.
Mrs. Fitzgerald, Ste. Cecile.
Bolduc and Lacourcière, St. Samuel.

Lacombe and D'Allaire, St. Sebastien, Que.: Lot 34, range IV, Whitton, Compton county. Alfred Lebonté, manager, St. Sebastien, Que.

This quarry is situated about half way between St. Sebastien and St. Samuel on the east side of the railway, to which it is connected by a tramway about a quarter of a mile long. The quarry is about 100 × 50 feet and 10 feet deep. The sheets are from 3 to 4 feet thick on the average, but in places a thickness of fully 8 feet is presented. The dip is a little west of north at a low angle. The major joints strike N. 20°W. and dip

PLATE XXVIII.

Megantic granite. Quarry of Lacombe and D'Allaire, St. Sebastien, Que.

80° to northward. A minor set crosses at N. 30°E. with a vertical dip. A shattered heading runs through the middle of the quarry in a direction a little east of north: this is being worked out in order to give a good working face. In the same general direction the rock is cut by small bands and stringers of fine grained material. Many of these, while quite apparent on horizontal surfaces, are scarcely to be distinguished on the vertical face. In addition to the joints the stone is cut by blind partings which would probably disappear with depth. While large stone can be obtained there is certain to be a considerable amount of waste. Despite the serious fracturing it is stated that pieces have been shipped, 17 ft. 3 in. long, 2 ft. wide, and 5 in. thick.

The rift is horizontal and the grain vertical in an east and west direction. (Plate XXVIII).

The stone: No. 788.—This granite is shown in Plate LII, No. 6: it is finer in grain than the Stanstead stone but it has not so clean a colour owing to a tinge in the quartz crystals. The microscope shows that the feldspars are rather more decomposed than in the Stanstead stone and that the alteration has affected the mica crystals also which have been partially converted into chlorite.

The physical properties are:

Specific gravity	2.682
Weight per cubic foot, lbs	165.663
Pore space, per cent	1.1053
Ratio of absorption, per cent, one hour	0.2442
" " " two hours	0.2442
" " " slow immersion	0.285
" " " in vacuo	0.3332
" " " under pressure	0.3975
Coefficient of saturation, one hour	.61
" " " two hours	.61
" " " slow immersion	.71
" " " in vacuo	.84
Crushing strength, lbs. per sq. in., dry	36,820.
" " " " wet	33,700.
" " " " wet after freezing	34,900.
Transverse strength, lbs. per sq. in	4,935.
Shearing strength, lbs. per sq. in	2,390.
Loss on corrosion, grams per sq. in	0.000312
Drilling factor, mm	3.5

This stone is much finer in grain than the other examples from the Megantic area but otherwise the product of all the quarries is much alike, although local differences, due to the relative development of the constituent minerals, are to be noted.

The equipment consists of one horse derrick, one hand derrick, 1,500 feet of track with cars, windlass and cable. Forty men are employed at times.

In 1911, 80,000 paving blocks were shipped, mostly to Quebec, and 3,000 cubic feet of building stone and monumental bases to Sherbrooke and Montreal.

Rough stone is quoted at 40 cents per cubic foot and paving blocks at $55 per 1,000, f.o.b. quarry siding.

Stone was cut for the church in Megantic in 1911; it may also be seen in the Hotel St. Louis, Montreal.

Alfred Lebonté, St. Sebastien, Lot 26, Con. IX and Lot 3, Con. X, Gayhurst, Beauce county.

Mr. Lebonté owns or holds leases on parts of the above lots. No work has been done on lot 26 but a couple of carloads were shipped from lot 3. It is stated that the stone is less cut by stringers than that of Lacombe and D'Allaire.

The stone: No. 787.—This granite is considerably coarser in grain but otherwise essentially the same as No. 788 page 165. The Stanhope stone shown in Plate LIII, No. 2 is of very similar appearance. The coarser grain and the less amount of black mica give a lighter effect to the polished surface.

Bolduc and Lacourcière, St. Samuel, Quebec.

This quarry is situated about half a mile south of Lacombe and D'Allaire on the opposite side of the railway. The excavations have been made along the side of a minor ridge at some distance from the mountain. The stone is horizontally sheeted but its maximum thickness in the northern quarry is not more than 2 feet In the south quarry, the stone is thicker—up to 4 ft. The jointing varies greatly along the ridge; in the north quarry the main set strikes northwest while in the south quarry the set nearly at right angles (N. 30°E.) is more pronounced. Much minor fracturing is present as well. The stone has fewer stringers than in Lacombe and D'Allaire's quarry but its general appearance is less attractive as large glistening feldspar crystals are scattered through the mass of the rock. It is eight years since this quarry was worked.

The stone: No. 789.—Practically the same as No. 787.

No. 790.—The same as No. 789 but is somewhat duller on fresh fractures, probably owing to a greater degree of decomposition in the feldspar crystals.

G. Fournier, Megantic, Que.

Mr. Fournier has quarrying rights on lot 29, range V, Frontenac, on the property of C. Champagne, Ste. Cecile. The quarry is situated about half a mile west of the main road between Ste. Cecile and St. Sebastien. There is very little stripping over a considerable area. The exposed sheet is 8-10 feet thick. The main joints strike N. 30°E. and are 6 or 8 feet apart. No cross joints were observed in the 15 feet exposed, but superficial diagonal partings appear in places. There is no doubt that very large stone could be quarried at this point, but operations have been suspended (791).

Mr. Fournier has also operated on the shore of Lake Megantic 6 miles below the town (786).

The stone: No. 786. This example is very like the other coarser grained stones from the Megantic area. There is rather more black mica and the general appearance is cleaner owing to purer colour in the quartz and feldspar crystals.

No. 791.- Resembles Nos. 787 and 789 but there is less black mica and the quartz is more abundant. As this last mineral has a light greyish pink colour its greater abundance reduces the white of the feldspar and gives a darker tone to the whole surface. An idea of the appearance of this stone may be obtained from Plate LII, No. 2, by reducing the amount of the white component (feldspar) and increasing the amount of the pinkish-grey portion (quartz).

Mrs. Fitzgerald, Ste. Cecile, Que.

This quarry is about half a mile west of the highway north of Ste. Cecile. At one time it was connected to the railway by a spur which has been abandoned. The quarry extends for 200 feet along the southeast side of a small hill and presents a face of 50 feet. The sheets are from 2 to 3 feet thick on the average, but 8 foot stone may be obtained in places. The sheets dip at a low angle to the southeast and are intersected by joints in the same direction. Some stone of unusual length may be obtained at this point.

The stone: No. 792.--This example is almost exactly the same as No. 791 from Fournier's quarry as it shows the same excess of slightly coloured quartz.

Summary Megantic Area.

Large masses of granite are exposed in both the Little and Big Megantic mountains and on the shore of Lake Megantic. The stone has been quarried on the lake shore and at several points along the line of the Quebec Central railway near St. Sebastien, St. Samuel, and Ste. Cecile. The stone varies from fine to medium in grain and generally presents a colour which is less pure than that of the Stanstead granite owing to a tinge in the quartz crystals. A fine grained example of the stone is shown in Plate LII, No. 6. The coarser varieties closely resemble the Stanhope stone shown in No. 2 of the same plate.

Most of the quarries are now out of commission but the finer grained type is still being quarried by Lacombe and D'Allaire of St. Sebastien. The church of St. Jean Baptiste in Sherbrooke is a good example of the use of Megantic granite for architectural purposes.

STANHOPE AREA.

A large mass of granite occurs on the international boundary in the township of Barnston, county of Stanstead. This region has long been known as a producer of granite for structural purposes but at the present time only one company is actually raising stone.

Frontier Granite Co., Henry Dunn, president, Stanhope, Que.

This company has operated on leased land at several points in the vicinity of Stanhope. The present workings are situated on the property of S. A. Baldwin where the stone is exposed on the face of a steep escarpment half a mile west of the railway station at Stanhope. Vertical joints striking north and south cut the formation at intervals varying from 10 to 40 feet. The sheeting planes are 4 or 5 feet apart on the average. Large blocks can be obtained but a considerable amount of waste material is produced.

The stone: No. 751.—This granite (Plate LII, No. 2) is very similar to the Stanstead stone from Charles Haselton's quarry described as No. 748 on page 162. The feldspar crystals are pure opaque white but the quartz lacks the clear water-white of the same component in the Stanstead stone. The Stanhope stone is also similar to some of the Megantic granites particularly those in which the feldspar is more abundant than the quartz as in No. 787. Under the microscope the quartz and feldspar are seen to occur in equally large crystals with the latter mineral frequently represented by the variety microcline. Many of the feldspar crystals are rather badly decomposed. Black mica is present in sparing amount.

The physical properties follow:—

Specific gravity	2.646
Weight per cubic foot, lbs.	163.012
Pore space, per cent.	1.312
Ratio of absorption, per cent, one hour	0.34
“ “ “ two hours	0.3688
“ “ “ slow immersion	0.402
“ “ “ in vacuo	0.44
“ “ “ under pressure	0.503
Coefficient of saturation, one hour	.67
“ “ “ two hours	.75
“ “ “ slow immersion	.79
“ “ “ in vacuo	.87

Crushing strength, lbs. per sq. in., dry	28,500
" " " " wet	25,900
" " " " wet after freezing	25,500
Transverse strength, lbs. per sq. in.	2,133
Shearing strength, lbs. per sq. in.	1,885
Gain on corrosion, grams per sq. in.	0.000256
Drilling factor, mm	4

The company has installed a small compressor which is operated by a gasoline engine. One derrick is in position in the quarry and a small finishing shop is in operation at the railway.

The company formerly quarried on the property of H. W. Marsh, of Norton Mills, N.H. This quarry is situated on lower land near the railway station at Stanhope. The major joints run due east and west at intervals of 10 to 20 feet. A second less well defined set strikes north and south. The quarry was about 100 feet by 50 feet and was opened to a depth of 8 feet.

The stone: This stone closely resembles No. 751 but it is of a somewhat darker colour: it may be seen in the post-office at Lake Megantic and in a school in St. Hyacinthe. The stone from the present workings is being shipped chiefly to Ottawa and Toronto.

Last year, 90 cars were shipped from Marsh's quarry; the production from the new quarry will probably be somewhat less for the present year (1912). Thirty to thirty-five men are employed.

Stanhope Granite Co., Rev. Amd. Goyette, president, Stanhope; M. J. Curot, manager, 672 Berri street, Montreal; capital stock, $150,000.

The property held by this company consists of parts of lots 24 and 25, range II, Barnston, Stanstead county.

As far as can be learned, legal difficulties have interfered with the developing of the property. With the exception of a few blocks from shallow pits, no stone has been raised and all operations have long since been discontinued.

The stone is either actually exposed or covered by a thin layer of drift over a considerable area. As far as can be seen it is of fairly uniform grain and is free from knots. On the other hand it is much splashed with veins and stringers of coarse pegmatite. The jointing is due north and south with infrequent cross joints so that pieces 12 feet long might be obtained.

The stone: No. 750.—This granite is essentially the same as No. 751 described on page 168.

Summary—Stanhope Area.

The granitic exposure in Barnston township, Stanstead county, near the international boundary, has been worked for the production of building stone and paving blocks. Stone has been quarried at several points in the lower country near Stanhope village, on the top of the hill to the west of the village, and from the face of the cliff to the westward of the railway. The only company now producing stone is the Frontier Granite Company of Stanhope. This firm is quarrying on the face of the cliff and has also established a small finishing shop at the railway.

The stone is a rather coarse grained granite of a light grey colour which is represented in Plate LII, No. 2. Owing to a tinge of colour in the quartz crystals the general effect is not as good as that produced by the Stanstead granite. This stone is similar to some varieties of granite from the Megantic area; it also resembles the stone from Haselton's quarry at Stanstead.

CHAPTER VI

BLACK GRANITES AND RELATED ROCKS.

The term "black granite" is used by quarrymen to designate the dark coloured igneous rocks in general. There would be no excuse for using the expression in a work dealing with the scientific classification of rocks as many varieties of widely different mineral composition, none of which are true granites, are commonly included among the black granites. In a work of the present kind, however, it seems advisable to retain a term which is in common use among quarrymen, monument makers, and builders.

The great majority of black granites are diorites, diabases, etc., which are characterized by the presence of plagioclase feldspar, and a dark coloured mineral such as mica, hornblende, or pyroxene. In the present work it is proposed to include all the darker coloured igneous rocks, although some of them are almost granitic in their appearance. In fact this chapter will include the rocks of igneous origin which are not true granites, syenites, or gneisses.

The only black granite actually on the market as a monumental stone is that quarried at Mount Johnson: to this may be added the stone from other of the igneous masses of the Eastern Townships which have been quarried to a small extent for building and ornamental purposes. Finally, it is proposed to include certain igneous rocks which are not of building or ornamental quality but which are largely used for macadam, etc. The chief example of this type of stone is the so-called banc rouge which is used in large amounts in Montreal.

The most important sources of black granites in the province of Quebec are the Monteregian hills, a series of intrusive igneous masses which broke through the Palaeozoic region of the Eastern Townships in late Devonian or early Carboniferous time. The most important of these hills are Montreal mountain, Mount Johnson, Yamaska mountain, and Shefford, Brome, Beloeil, Rougemont, and Montarville mountains.

Certain rocks of possible value from the present point of view also occur in Orford mountain and at other points in the Eastern Townships and in the great Pre-Cambrian region of the north. It will be convenient therefore to consider the black granites under three areas—The Monteregian hills, the Pre-Cambrian of the Eastern Townships, and the Pre-Cambrian of Northern Quebec.

Monteregian Hills.

The following brief account of the geology of the Monteregian hills has been compiled from the excellent description given by Dr. Frank D.

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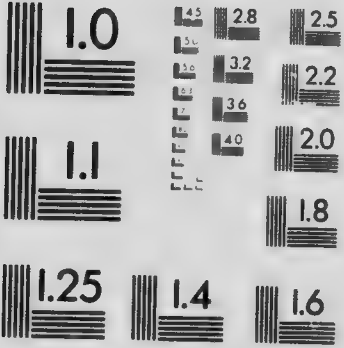

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Rochester, New York 14609 USA
(716) 482 - 0300 - Phone
(716) 288 - 5989 - Fax

Adams in the guide book to Excursion A 7 of the Twelfth International Geological Congress. The bibliography appended to this section is also derived from the same source.

" The distance from Brome mountain, the most easterly member of the Monteregian hills to Mount Royal the most westerly is 50 miles." Six of the mountains, Mount Royal, Montarville, Belœil, Rougemont, Yamaska, and Shefford, lie approximately along a straight line, while Mount Johnson, and Brome mountain form a parallel line to the south. "It is highly probable, in view of this distribution, that these ancient volcanic mountains, are, as is usual in such occurrences, arranged along some line or lines of weakness or deep seated fracture. The Monteregian hills are a series of ancient plutonic intrusions. Some of them (e.g. Brome mountain) are apparently denuded laccoliths, one of them (Mount Johnson) is a typical neck or pipe, and it is probable that some, if not all of them, represent the substructures of volcanoes which at one time were in active eruption in this region.

"The Monteregian hills form an exceptionally distinct and well marked petrographical province, being composed of consanguineous rocks of very interesting and rather unusual type. They are characterized by a high content of alkali, and in the main intrusions of almost every mountain two distinct types are found associated with one another, representing the products of the differentiation of the original magma—nepheline syenite and essexite (Fig. 7).

Mount Royal.

This mountain is composed of two distinct intrusive masses essexite[1] and nepheline syenite[2] neither of which are systematically quarried for building purposes and consequently require no further notice here.

The main intrusions which form the mass of the mountain were followed by the injection of sheets and dykes of igneous rocks into the surrounding Trenton limestones. While none of these dyke rocks are of importance as building material they have been largely quarried for macadam and concrete and consequently will be briefly considered. Dr. Adams mentions nine distinct types of rocks but for our present purpose only one is of importance. This rock, tinguaite, known locally as banc rouge, occurs in sheets in the quarries mentioned below and also in the form of dykes in some of the regular limestone quarries.

The following list includes the chief operators in the banc rouge of Montreal and vicinity:—

---

[1] The essexite is composed essentially of purplish pyroxene, brown hornblende, plagioclase and a little nepheline.

[2] The nepheline syenite is a lighter rock of a medium grey colour and of finer grain than the essexite. It is composed of orthoclase, nepheline and hornblende with a little pyroxene and mica and numerous accessory minerals in small amount.

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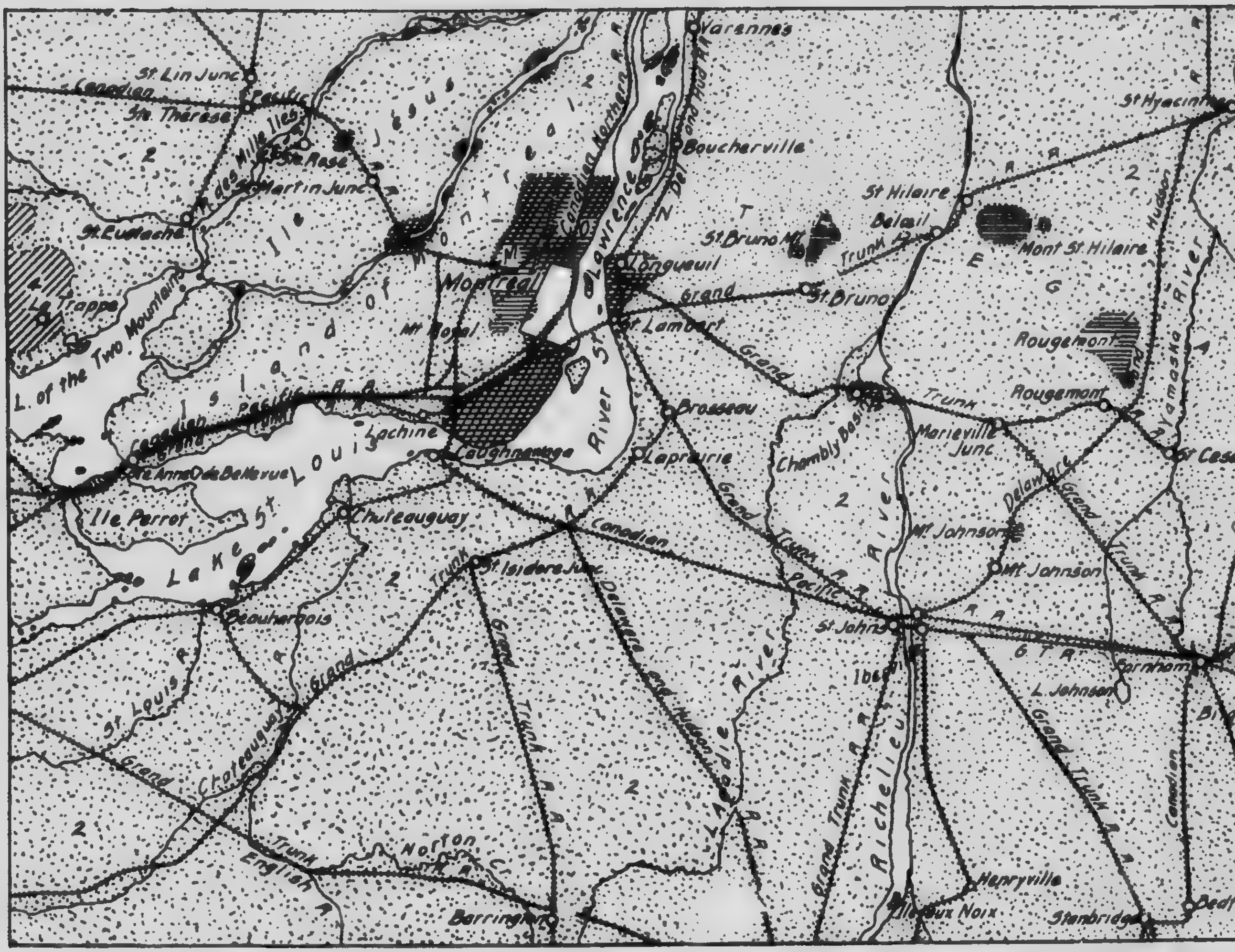
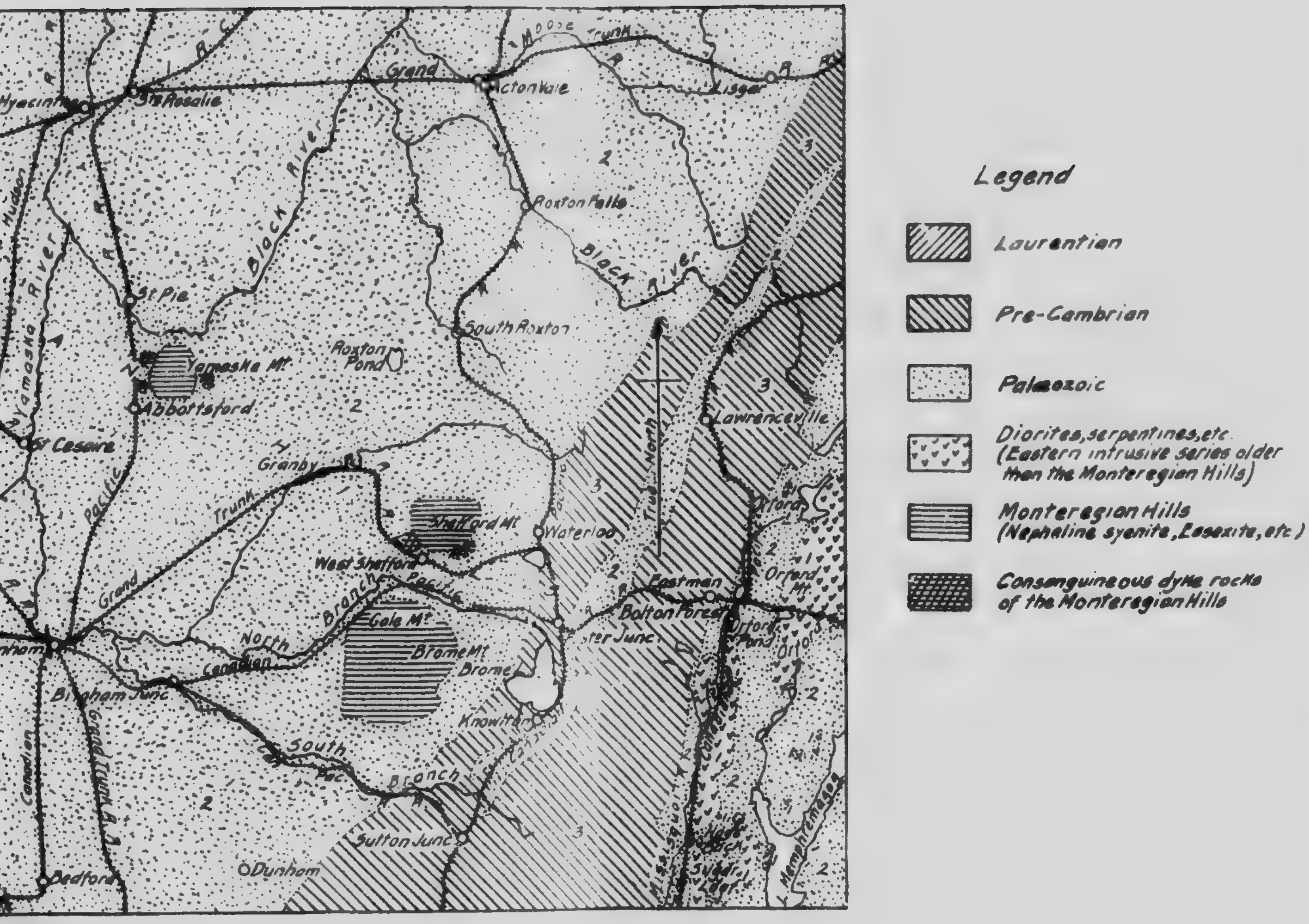


From Guide Book No. 3 Twelfth International Geological Congress

Fig. 7. Sketch map of the Monteregian hills.


Legend
Laurentian
Pre-Cambrian
Palaeozoic
Diorites, serpentines, etc.
(Eastern intrusive series older than the Monteregian Hills)
Monteregian Hills
(Nephaline syenite, Essexite, etc.)
Consanguineous dyke rocks of the Monteregian Hills
Acton Vale
Ste Rosalie
Grand Trunk
Lisgar
Roxton Falls
Black River
South Roxton
Roxton Pond
St Pie
Yamaska Mt.
Abbottsford
St Cesaire
Granby
Shefford Mt.
Waterloo
West Shefford
Pacific
North Branch
Canadian
Gale Mt.
Brome Mt.
Brome
Knowlton
South Branch
Sutton Junc.
Dunham
Bedford
Bolton Forest
Eastman
Lawrenceville
Orford Mt.
Orford Pond
Memphremagog
Bingham Junc.
North
2
3
egian hills.

Morrison Quarry Co. (DeLorimier Ave. quarry).
Keegan and Dillon.
Lionais, Limited.
Rogers and Quirk (southern quarry).
Joseph Pourpore.
Joseph Rhéaume, Maisonneuve.
The Fire Proof Crushed Stone Co.
The Lortie Quarry Co.

Morrison Quarry Co., O. Martineau et Fils, operators, 371 Marie Anne St., Montreal.

This quarry has been described under limestone on pages 37-39.

The stone: No. 581.—To the naked eye this stone presents a fine grained, dark grey surface with scattered glittering needle-like reflections. The mineral composition is very complicated and need not be considered here: it is essentially an aphanitic rock of the nepheline-syenite class, containing some rare minerals which render it strongly radio-active. The physical properties follow:—

Specific gravity	2.548
Weight per cubic foot, lbs	158.85
Pore space, per cent	0.125
Ratio of absorption, per cent, one hour	0.0237
" " " two hours	0.0237
" " " slow immersion	0.0237
" " " in vacuo	0.0366
" " " under pressure	0.0497
Coefficient of saturation, one hour	.476
" " " two hours	.476
" " " slow immersion	.476
" " " in vacuo	.736
Crushing strength, lbs. per sq. in., dry	45,700.
" " " " wet	44,700.
Transverse strength, lbs. per sq. in[1]	468.
Shearing strength, lbs. per sq. in	3,320.
Loss on corrosion, grams per sq. in	0.000925
Drilling factor, mm	4.

The following analysis is given by Adams in Guide Book No. 3., International Geological Congress, 1913:—

---

[1] This result is quite useless as the slab broke on a flaw. It is practically impossible to prepare a slab free from flaws.

	per cent.
Silica	50.40
Titanium oxide	0.50
Alumina	21.83
Ferric oxide	2.51
Ferrous oxide	1.41
Manganese oxide	0.27
Calcium oxide	3.17
Barium oxide	0.33
Tin oxide	0.07
Magnesium oxide	0.39
Sodium oxide	9.96
Potassium oxide	6.10
Phosphoric oxide	0.10
Chlorine	0.10
Sulphur trioxide	0.62
Water	0.56
	100.26

It has already been mentioned that this stone is not adapted to purposes of fine construction as it is too hard and too subject to decay. The description is introduced on account of the large amount of this stone that is used for road metal and other purposes in the city of Montreal.

Keegan and Dillon, 40 Hospital Street, Montreal.

The quarry is described on page 39. The stone does not differ from that of the adjoining property.

Rogers and Quirk, 1701 Iberville Ave., Montreal.

From 5 to 15 feet of banc rouge are exposed in this quar[illegible]s described on page 40.

The stone: No. 582.—This stone is very fine grained and hard and presents a light green colour. It is a lighter and finer grained rock than No. 581 and is of no value as a building stone.

Wm. Joseph Pourpore, 124 Board of Trade building, Montreal.

This quarry has been described on page 42. The upper six feet consists of typical banc rouge.

Joseph Rhéaume, Maisonneuve, Quebec.

A sheet of tinguaite as much as 20 feet thick in places is found on this property in Côte La Visitation. A full description of the quarry is given on pages 42-44.

Fire Proof Crushed Stone Co., J. A. A. Belanger, president, 2650 Masson Street, Montreal.

This quarry is opened on an extensive belt of banc rouge which is said to have a thickness of 45 feet. The formation forms a distinct ridge rising above the surrounding level.

The quarry has recently been opened and is about 100 feet square and 20 feet deep. A good steel derrick of 5 tons capacity has been erected. Two Rand drills operate on air from a compressor actuated by electric power. Two jaw crushers having a capacity of 300 tons a day are installed. Crushed stone is quoted at 85 cents to $1.25 per ton according to size. Twenty-two men are employed.

The stone: No. 900.--This example is coarser in grain and lighter and more greenish in colour; otherwise it is the same as No. 581, page 173.

Lortie Quarry Co., 61 St. Gabriel St., Montreal.

This company holds property on each side of Valois street south of Masson street. The lots reach half way to Bourbonnière street and the same distance west of Valois street. The company has installed a 100 ton Austin crusher, two boilers and two drills. Very little work has yet been done. The stone is identical with No. 900.

The Morrison Quarry Company propose to open new quarries to the southeast of the holdings of the Lortie Quarry Co.

Mount Johnson.

Mount Johnson is situated in the parish of St. Gregoire le Grand, county of Iberville, about 6 miles east of the city of St. Johns. The area of the eruptive mass is about half a square mile and its greatest elevation 685 feet above the surrounding plain. Dr. Adams considers that the mountain consists of three peripheral zones of different kinds of rocks which pass imperceptibly one into another. The outermost and consequently lowest zone consists of *pulaskite*, a soda bearing syenite of a pale yellow or buff colour which is not suitable for building or monumental purposes. The second zone extends about half way up the mountain and consists of coarse grained, dark coloured essexite (andose) known to the quarrymen as *Canadian Quincy* and described below as No. 703. The upper 150 feet of this zone is finer in grain and is known as *Ebony* (702). The third zone extends to the top: it presents a rock of still finer grain determined as essexose by Dr. Adams and known locally as the fine grained type. (704).

Quarries have been opened by two companies at about the upper level of the coarse stone and have been extended through the medium grained type into the overlying fine grained stone.

The rock is divided by well marked but irregular sheeting planes which conform, in a general way, to the configuration of the hill. In some places the sheets dip as high as 45° but generally the slant is much less. The sheets vary in thickness from a few inches up to 15 feet. The rift is practically vertical in all the quarries and is quite independent of the sheeting planes.[1] The direction varies from place to place as the structure is disposed in a circular manner around the mountain and thus conforms to the border of the rock mass. On weathered surfaces, the rift is plainly visible in some places while in others it is practically absent. Experience in quarrying shows the same irregular development of rift, as in some sections it is so feeble as to be negligible for quarrying purposes. The grain (run) is horizontal and is independent of the sheeting planes which are often cut at a low angle by the planes of parting. In some of the quarries the grain is more pronounced than the rift.

The jointing is irregular, and, in some places, excessive. The major set strikes approximately with the rift, but may dip either way from the vertical. These planes of parting are not continuous but they are usually fairly widely spaced. The second set is disposed at right angles to the former and cuts the formation vertically. In places, these joints are 100 feet or more apart, but in others, they are close set and cause fractured zones or headings of considerable width. In addition to these two sets, other irregular fractures so divide the formation that the rock is rather severely broken on the whole.

The stone is practically free from black knots but much loss is occasioned by the presence of fine white lines lying parallel to the grain. Two companies are operating as below:

Mount Johnson Quarry Co., 35 St. Jacques St., Montreal.

The company is operating on the southeast side of the mountain where quarries were opened about 15 years ago. Several acres have been quarried in a scattered manner, but at the present time, two main openings are being worked. The eastern opening is situated in the upper 50 feet of the coarse grained lower stone known as Canadian Quincy (703).

The western and larger quarry is at a slightly greater elevation and extends through the medium grained stone (Ebony, 702) to the fine grained material above (704). At this point the grain is horizontal and the rift vertical at N. 60°E.

The main joints vary from N. 60°E. to N. 30°E. and dip at varying angles in both directions from the vertical. A second series of joints dipping vertically, strikes into the mountain at about N. 30°W. Towards the eastern end of the opening these joints are closely set and give rise to a heading of 50 feet or more in width; westward they are more widely spaced and do not interfere with the extraction of large blocks. At the top of the quarry a third well defined set of joints strikes N. 20°E. and dips 45° into the mountain, i.e. westwardly.

[1] Dr. Adams considers that the rift is an expression of vertical flow structure.

PLATE XXIX

Black granite. Quarry of the Mount Johnson Quarry Co., Mount Johnson, Que.

The sheeting is irregular and different layers are shown in different parts of the quarry. The upper sheet, now largely removed, is 12 feet thick, the second layer averages about 10 feet, while the lower sheets are more variable but nearly always capable of yielding stone 4 or 5 feet thick.

The stone is free from flaws as far as black knots are concerned but it is marred in places by the presence of fine white lines disposed in a horizontal manner. The presence of these flaws together with the irregularity of the jointing cause the loss of 75 per cent of the stone quarried, as the practice is to ship only the perfect material for monumental work (Plate XXIX).

The stone: No. 702. This example is shown on Plate LII, No. 9; it is the medium grained type of Mount Johnson stone. With regard to the light minerals, the rock is composed essentially of lath-shaped crystals of plagioclase associated with nepheline and a small amount of orthoclase. All these constituents are in a fairly good state of preservation. The dark minerals are biotite or black mica, hornblende and pyroxene, of which the hornblende is the most abundant and the pyroxene the least important. Magnetite occurs in association with the mica and pyroxene.[1]

The physical properties are as follows:

Specific gravity		2.836
Weight per cubic foot, lbs.		176.6
Pore space, per cent		0.249
Ratio of absorption, per cent,	one hour	0.0423
" " "	two hours	0.0423
" " "	slow immersion	0.0572
" " "	in vacuo	0.0613
" " "	under pressure	0.0883
Coefficient of saturation	one hour	.48
" " "	two hours	.48
" " "	slow immersion	.65
" " "	in vacuo	.69
Crushing strength, lbs. per sq. in.,	dry	40,900.
" " " "	wet after freezing	39,630.
Transverse strength, lbs. per sq. in.		3,265.
Shearing strength, lbs. per sq. in.		2,140.
Gain on corrosion, grams per sq. in.		0.000369
Drilling factor, mm.		3.8

The stone is not measurably affected by water or frost. The gain on corrosion is unexpected and at variance with the results obtained from the other varieties: it requires verification.

No. 703.—This is the coarse variety of Mount Johnson stone and is shown in Plate XXX. This stone is essentially the same as No. 704

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[1] Dr. Adams finds that the relative abundance of the dark minerals varies and states that the hornblende is usually in excess of the others.

except for the coarser structure. The black minerals are hornblende with less mica and a very little pyroxene. The feldspars and nepheline are in a better state of preservation than in No. 702.

The physical properties are:—

Specific gravity	2.876
Weight per cubic foot, lbs	179.22
Pore space, per cent	0.288
Ratio of absorption, per cent, one hour	0.047
“ “ “ two hours	0.052
“ “ “ slow immersion	0.0763
“ “ “ in vacuo	0.0763
“ “ “ under pressure	0.1005
Coefficient of saturation, one hour	.46
“ “ “ two hours	.51
“ “ “ slow immersion	.75
“ “ “ in vacuo	.75
Crushing strength, lbs. per sq. in., dry	36,500.
“ “ “ “ wet after freezing	36,000.
Transverse strength, lbs. per sq. in	2,411.
Shearing strength, lbs. per sq. in	1,955.
Loss on corrosion, grams per sq. in.	0.00176
Drilling factor, mm	4.1

No. 704.—This example represents the fine variety of Mount Johnson stone and was obtained from a higher level than the two varieties already described; it is represented in Plate LII, No. 10. The stone is essentially like the other two varieties but much finer in grain. Pyroxene is the most abundant of the dark minerals with mica and hornblende in less amount. Olivine is also present. The physical properties are as follows:—

Specific gravity	2.844
Weight per cubic foot, lbs	176.896
Pore space, per cent	0.362
Ratio of absorption, per cent, one hour	0.0692
“ “ “ two hours	0.0801
“ “ “ slow immersion	0.0928
“ “ “ in vacuo	0.1071
“ “ “ under pressure	0.1277
Coefficient of saturation, one hour	.54
“ “ “ two hours	.62
“ “ “ slow immersion	.72
“ “ “ in vacuo	.84
Crushing strength, lbs. per sq. in., dry	41,300.
“ “ “ “ wet after freezing	42,100.
Transverse strength, lbs. per sq. in	2,790.

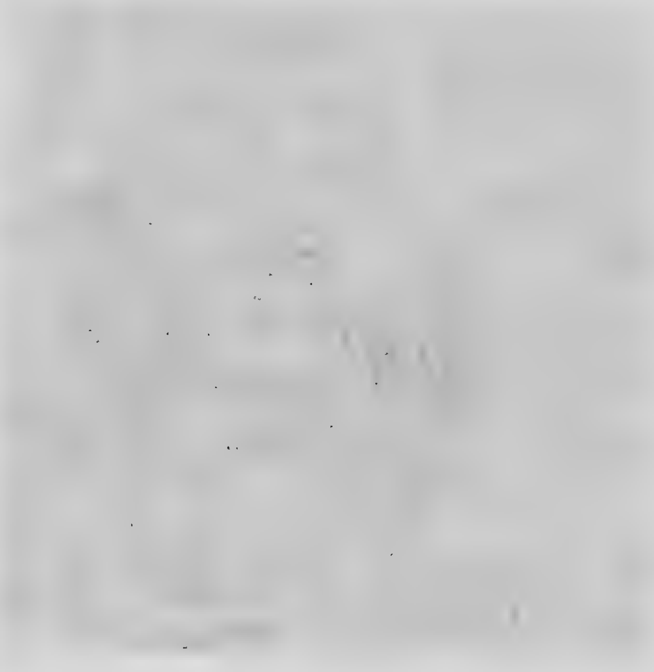

Plate XXX.

Black Granite "Canadian Quincy." Mount Johnson Quarry Company, Mount Johnson, Que.

Shearing strength, lbs. per sq. in.	2,382.
Loss on corrosion, grams per sq. in.	0.00176
Drilling factor, mm.	4.1

An examination of the physical properties of these three similar stones, in which the difference in grain is practically the only variation, shows that the crushing, transverse and shearing strengths increase with the fineness of grain except that the medium grained example has the highest transverse strength. The specific gravity is not related to the structure and varies with the relative amounts of dark minerals: it is highest in the coarse type. While the porosity tests vary slightly the general conclusions are the same in each instance. The drilling factor is practically the same in all three examples.

Quarrying is effected by the use of black powder in Lewis holes. The blocks are squared by plug and feathers, the plug holes being drilled by hand. Two derricks of ten tons capacity each are installed; one is operated by horse power and the other by hand. From six to ten men are employed throughout the year. There is a haul of about ½ mile to a siding of the Q. and M. railway.

James Brodie and Son, Iberville, Que.; Part of Lots 156–159, Parish of St. Gregoire le Grand, county of Iberville.

This firm holds about 60 acres of quarry lands on the northwest side of the mountain. Operations were begun in 1899 and openings have been made at several points. The quarry now being worked is about 100 feet square but these dimensions are by no means indicative of the extent of the operations. Both the jointing and the sheeting are very irregular. The most pronounced joints strike N. 80°W. and dip 70° southward or into the mountain. Another set cuts the formation, N. 20°E., vertically. On the whole however it can scarcely be said that well defined systems of joints exist as the formation is badly shattered in various directions. The rift is vertical at 20° east of north, but in some places it is scarcely perceptible. The grain is horizontal, and when the rift is feeble or absent, it becomes the most apparent plane of separation. The sheeting planes are very irregular and they show a variable dip, sometimes as great as 25°, away from the mountain.

The stone: The three types of stone already described from the Mount Johnson Quarry Co., are presented here with no practical variation.

Flawless blocks suitable for monumental purposes constitute about 20 per cent of the total stone quarried. Of recent years Messrs. Brodie have utilized some of the waste material for paving stones, but the failure of the rift in certain parts of the quarry renders the making of blocks too difficult to meet with financial success.

One derrick is at present in operation.

Two men are employed on the average although as many as sixty have at times been engaged. Quarrymen receive from $2 to $2.25 per day and labourers $1.75. About 6,000 cubic feet of high grade monumental stone are shipped per annum. The stone in roughly squared blocks is valued at 90 cents per cubic foot, f.o.b. quarry siding. The product is nearly all used for monumental purposes, chiefly in Ontario.

Paving stones, 9-14 in. long, 5 in. deep and 4½ in. wide are valued at $50 per 1,000, f.o.b. siding. The firm operates a small mill in Iberville of which the following details are sufficient for the present purpose:—

Mill building, 100 feet by 40 feet with motor and compressor room in addition.

Electric power is used and distributed as follows:

One motor, driving line shaft and small compressor.
One motor, driving large compressor.
One large polishing machine, Smith, Whitcombe and Cook, Barre, Vt.
One small polishing machine, Patch Manufacturing Company.
Two surfacing machines, Trow and Holden, Barre, Vt.
Twenty stations for pneumatic tools.
Crane, running the length of the mill.
Fifteen men are employed on the average.

Narcisse Lord, St. John, Que.

The property is situated about 2½ miles north of the city of St. Johns in the parish of St. Luke, county of St. Johns. The quarry is opened in the brow of a slight elevation and presents a semicircular working face of about 300 feet. The maximum depth does not exceed 8 feet. The stone is divided into irregular sheets by undulating parting planes which occur at intervals varying from a few inches up to 3 feet. The jointing is very irregular with a major series striking N. 20°E. The upper stone is soft but the lower layers increase greatly in hardness. The output is crushed on the property for use as road metal. Some large blocks have been used in works of heavy construction but the stone presents no possibilities as a building material of the finer kind. About 10 acres of stone is easily accessible either on this property or on the adjoining lots.

The stone: No. 701.—A light grey volcanic rock in an excessively altered condition. It seems to have contained lath-shaped feldpars and large mica or hornblende crystals. The whole mass of the rock is so decomposed that a considerable amount of secondary carbonate of lime has been formed.

Yamaska Mountain.

Yamaska mountain is situated in the township of Shefford between the villages of Abbotsford and St. Pie; it occupies an area of five and three quarter square miles and rises to an elevation of 1200 feet above the surrounding plain, or 1470 feet above the sea. With regard to the igneous rocks Dr. Young makes the following statement. "The igneous core of Mount Yamaska has an area of three and one tenth square miles and its outline, though very irregular, approximates an ellipse. The different varieties of the igneous rocks form a series ranging from a syenite of the akerite type to a very basic rock allied to jacupirangite and composed chiefly of pyroxene, hornblende, iron ore, and small but varying amounts of basic plagioclase feldspar; for this rock the name *Yamaskite* is proposed. .... These varieties are grouped in three divisions under the headings of akerite, essexite and yamaskite. While in general the rock of any locality can be more or less readily assigned to one of these three groups, it is not to be inferred that the different types are sharply distinguished from one another or that they necessarily belong to different periods of eruption.....................

"The akerite type occurs as a narrow band along the western border and in a small detached area on the western side of the igneous core. The yamaskite forms two main areas, one occupying nearly the centre of the mass and extending about to the middle of the southern border while the other occurs near the eastern boundary. The varieties classed under essexite occupy the remaining portions of the mountain and form somewhat over two-thirds of the cross section of the igneous core, while the akerite occupies about a tenth and the yamaskite a fifth."[1]

The yamaskite and the akerite are of no importance from the present point of view as the only quarries that have been worked are situated in the essexite. Dr. Young recognizes two main varieties of this rock which he designates as *coarse to fine grained, granular or porphyritic* and *medium to coarse grained, trachytic.* The first of these three varieties is divided into three sub-varieties.

Canadian Pacific Railway Company

A quarry was opened by the Canadian Pacific railway on the western side of Yamaska mountain at a considerable height above the village of St. Pie and at a distance of 3½ miles. The old excavation is about 200 by 100 feet and has been sunk to an average depth of 6 feet. The sheets vary from 2 to 4 feet in thickness and are not uniform; they dip with the mountain, W. 20°N. at from 20° to 30°. The joining is not excessive and permits the extraction of large stone in certain parts of the quarry. In other places fractured headings occur with close jointing in both southeast and northeast directions. The main joints are independent of these headings and strike E. 10° N. The formation is cut, S. 30° W. by white stringers which are so numerous that it would be difficult to obtain large blocks without this imperfection. On the other hand neither knots nor pyrite are to be seen throughout the exposure. The grain of the stone is fairly uniform but there is a different appearance on fractured faces according to the direction in which the stone has been split.

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[1] Geol. Sur. Can., Report 1904, pp 16-17 H.

No. 836 described below is a coarser type and No. 837 is typical of the best stone in the quarry. When exposed the stone weathers brown and presents a rather unattractive dull appearance. A building in the vicinity shows that the stone is much less uniform than the observations made in the quarry would indicate, for different blocks present a decidedly different appearance. I understand, however, that this stone was obtained from a lower level.

The stone: No. 837.—This stone has the grain and colour represented in Plate LII, No. 7. The rather dirty colour of the light components detracts from the value of the stone as an ornamental material. Under the microscope the chief component is seen to be plagioclase feldspar in long lath-shaped crystals. Most of these are in a good state of preservation but incipient decay is to be observed in others. The dark minerals are biotite (black mica) as the chief component with hornblende and pyroxene in less amount. Small grains of magnetite also occur.

The physical properties are:

Specific gravity	2.757
Weight per cubic foot, lbs	170.401
Pore space, per cent	0.092
Ratio of absorption, per cent, one hour	0.2295
" " " " " two hours	0.2295
" " " " " slow immersion	0.279
" " " " " in vacuo	0.312
" " " " " under pressure	0.3645
Coefficient of saturation, one hour	.62
" " " two hours	.62
" " " slow immersion	.76
" " " in vacuo	.85
Crushing strength, lbs. per sq. in., dry	29,420.
" " " " " " wet	25,080.
" " " " " " wet after freezing	23,950.
Transverse strength, lbs. per sq. in	1,745.
Shearing strength, lbs. per sq. in	1,890.
Gain on corrosion, grams per sq. in	0.000163
Drilling factor, mm	2.2

No. 836.—Differs from No. 837 in grain only.

The Canadian Pacific railway used the output in the construction of bridge piers; it may also be seen in the church at St. Cesaire.

Brome and Shefford Mountain.

Brome mountain comprises an area of about 30 square miles in the townships of Brome, East Farnham, and Shefford. The highest point of of the mountain is 1500 feet above mean sea level. The general description of the igneous rocks given by Dr. Dresser is as follows: [1]

"The igneous rocks of which Brome mountain is essentially composed are of three principal types, each of which is probably the product of a separate irruption. There are also several different facies of two of these types, which are the results of magmatic differentiation in the individual masses. The rock of the first intrusion ranges from essexite to theralite. The rock of the second is of a syenitic character and passes, by the loss of accessory quartz and the addition of nepheline from nordmarkite to nepheline syenite. The third and latest irruption seems to have been much smaller in volume, shows very little variation, and has the characteristics of a tinguaite."

The only one of these varieties which has been employed for structural purposes is the nordmarkite which has been quarried along the northern flank of the mountain to the west of West Shefford and also to the east of that place on the road to Sheffington.

Shefford mountain lies about 2 miles north of Brome mountain and consists of a series of closely related rocks. Dr. Dresser considers that the nordmarkite which is the only stone quarried belongs to the same intrusion as that of Brome mountain.

Stone has been quarried on the northern side of Brome mountain (Gale mountain) at several points, more particularly on lot 3, range IV of East Farnham by Morris Halley, on lots 4, 5, and 6 of the same range by H. Larose, and on lot 26, range I of Brome by W. E. Jones. On the northern side of Shefford mountain a little work has been done on the property of Peter Ducharme in range VI of Shefford.

Morris Halley, West Shefford, Que.

About 25 acres of stone are exposed on the south half of lot 3 in range IV of East Farnham. On the north side of the ridge where quarrying has been attempted the sheets dip southwest at a low angle. The upper layer is 2 feet thick and the lower sheets are very much thicker. Clean vertical joints run down the dip and cross joints are not observed. The stone is of very uniform character free from veinlets or blotches of any kind. Quarrying operations could be carried on from the surface and blocks of any desired size obtained with ease (931). Cliffs of the same stone with vertical joints and free from shattering are seen to the southward towards Gale pond, while towards the east the mountain rises to a greater height.

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[1] Geol. Sur. Can., Report 1904, p. 8 G.

The stone: No. 931. This rock is of medium to coarse grain with the greyish-pink colour shown in Plate LII, No. 5. It is composed of a large percentage of lath-shaped plagioclase crystals and a much less amount of biotite, pyroxene and hornblende. Other unimportant constituents occur in less amount.

H. Larose, West Shefford, Que.

Many large boulders are scattered along the base of the mountain on the south halves of lots 4, 5, and 6, range IV of East Farnham. These boulders have been used for cutting stone for building purposes (930). The church of St. Francois Xavier in West Shefford was in part constructed of this stone (Plate XXXI).

The stone: No. 930.—This stone is shown in Plate LII, No. 5; it does not differ essentially from No. 931.

In the church mentioned above the stone seems to have become darker and to have weathered deeply but uniformly. It now presents a light brownish grey colour, and clearly shows both pink and white feldspar crystals. The decay of the dark minerals is most pronounced.

Wm. E. Jones, West Shefford, Que., Lot 26, Range I Brome.

Mr. Jones has cut stone from boulders on his property and also from solid ledges like those on Halley's farm. The stone here is of somewhat lighter colour and is described below as No. 932.

The stone: No. 932.—This stone is very similar to those described above; it is rather fresher, however, and contains more white feldspar and less of the pinkish variety.

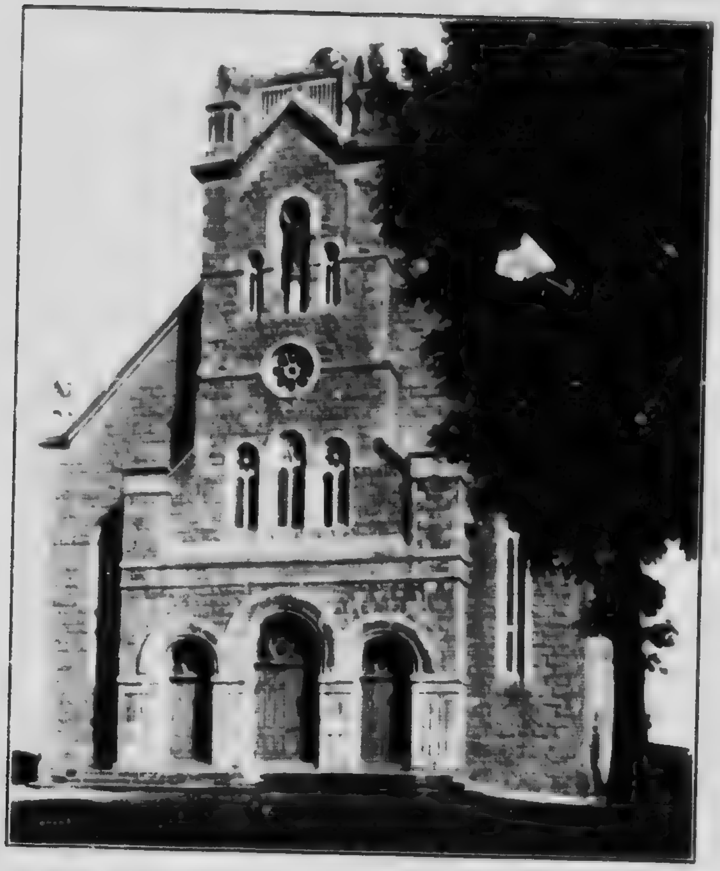
This stone may be seen in the English church in West Shefford.

The stone for the Canadian Pacific Railway bridge over the Yamaska river at Sheffington was obtained from the Hayes quarry near the road between West Shefford and Sheffington.

Peter Ducharme, Shefford Mountain, P.O. Que.

A very small opening has been made on Mr. Ducharme's property in the sixth range of Shefford. The sheeting is irregular and joints are frequent at the old quarry but it is said that the formation is more regular farther up the mountain. An unlimited quantity of stone is available (935).

The stone: No. 935.—This stone is of finer grain than the average rock from Brome mountain but it is essentially the same in structure and mineral composition. The specimen was obtained from the surface and shows an advanced stage of weathering with a serious decay of the ferromagnesian constituents and a consequent staining of the surrounding feldspars. The specimen shows scattered pure white feldspars, leading



Brome Mountain nordmarkose. Church at West Shefford, Que.

to the inference that at depth this stone would probably be of purer colour It is not to be denied however that the stone is subject to excessive and deep weathering.

St. Bruno Mountain.

St. Bruno mountain or Montarville is situated in the county of Chambly 14 miles from Montreal. The area is about 3 square miles and the maximum elevation 715 feet above sea level or 618 feet above St. Bruno station. The area above the 300 feet contour is 2.83 square miles of which the part occupied by igneous rock makes up 2.16 square miles.

"By far the greater part of St. Bruno mountain is composed of a mass which ranges from essexite to peridotite .... It is a dark greenish-grey rock, which weathers to a rusty brown colour. It is coarsely crystalline, and in the hand specimen there can be seen augite, biotite, feldspar, and occasionally olivine. The augite appears to be identical with that which occurs in the essexite of Mount Royal."

I have been unable to learn of any systematic quarrying having been attempted on St. Bruno mountain. It would appear that the stone is too coarse and too subject to decay to warrant its use for structural or monumental purposes.

Belœil and Rougemont Mountains.

These mountains lie between St. Bruno and Yamaska; Belœil or St. Hilaire mountain rises 1,437 feet above the sea and Rougemont reaches an altitude of 1,250 feet. The stone resembles that from St. Bruno and Yamaska but differs in petrographic detail. I have not learned of any regular quarrying on either mountain.

Summary, Monteregian Hills.

The series of eruptive hills which appear through the Eastern Townships from Montreal mountain to Brome mountain are possible sources of supply for the dark coloured rocks indefinitely known as black granites. Montreal mountain is of little interest from the present point of view but the dykes and sheets which cut the Trenton limestones in the vicinity have been largely quarried for concrete and macadam. A description of a typical example of this stone which is known locally as *banc rouge* in given on page 173.

The valuable rocks for building and monumental purposes are presented by Yamaska and Brome mountains and more particularly by Mount Johnson. The Yamaska mountain stone is of brownish grey colour and is represented in Plate LII, No. 7: a full description is given on page

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[1] Geol Sur. Can., Report 1077, 1910, pp. 14-15.

182. The Brome and Shefford Mountain stone is somewhat similar to that from Yamaska mountain but it is of coarser grain and lighter colour: it is described on page 184 and is shown in Plate LII, No. 5. No regular quarrying is now carried on at either of these localities.

The Mount Johnson stone is more typically a "black granite" as the colour is distinctly dark. Three varieties are known—a fine, a medium, and a coarse grained type. These three types have been described in detail on pages 177-179. The coarser type is represented in Plate XXX and the fine grained variety in Plate LII, No. 10. The Mount Johnson black granite is probably the best known stone of this kind that is now being quarried in Canada.

Literature:—Twelfth International Geological Congress, Guide Book to Excursion A 7, 1913. (Adams).

Geol. Sur. Can., Rep. No. 1077, 1910 (Dresser, St. Bruno mountain).
Jour. Geol. April, 1903 (Adams, The Monteregian Hills).
Geol. Sur. Can., Rep. 1904. Part H (Young, Mount Yamaska).
Geol. Sur. Can., Rep. 1904 Part G (Dresser, Brome mountain).
Geol. Sur. Can. Rep. 1900 Part L (Dresser, Shefford mountain).
Geol. Sur. Can., Rep. No. 1311, 1914 (O'Neill, Beloeil and Rougemont).
Geo. Sur. Can., Rep. 1894, pp. 71-74 J. (Ells, general description).

Other Igneous Rocks of the Eastern Townships.

The dark dioritic stones which occur in association with Pre-Cambrian and later rocks in this area are not necessarily of Pre-Cambrian age. It is convenient, however, to group them together as they are not comparable in composition, origin or age with the rocks of the Monteregian hills. Our knowledge of these stones from the point of view of this report is practically nothing, as with one exception, no attempt has been made to quarry them for building or ornamental purposes. It must be admitted, however, that possibilities exist in the area for the working of this class of stone and in consequence a brief compilation of the published accounts is given below.

"Dioritic rocks are found at many points throughout the Townships, sometimes in masses of large extent, as in the Big and Little Ham mountains, and in the peaks along the western side of Lake Memphremagog; at others, as bosses and dykes........ The largest and most important areas are found in a belt which can be readily traced from the Vermont boundary, northeast for over 100 miles, crossing the Chaudière river, and extending into the townships of Cranbourne and Ware.

"Throughout the greater part of this area, the dioritic rocks are intimately associated with the quartzites, quartziferous schists and black, red and green slates which are now described under the head of Cambrian. To the southwest, the most prominent features are Hawk, Bear, Owl's Head, Sugar-Loaf, Elephantis, and Hogs-back mountains, some of which may mark the sites of extinct volcanoes. These hills are situated near the west side of Lake Memphremagog south of Sargent's bay, and about four miles due northwest from the foot of Memphremagog lake are the great masses of dioritic and serpentinous rocks which form the Orford or Victoria mountains. . . . .The Ham mountains apparently divide this belt into two areas; the southwestern portion is occupied by smaller outcrops of volcanic rocks, seen in a number of hills, some of which are of small extent, in the vicinity of Brompton, Long, and Orford lakes, where dioritic and serpentinous rocks are closely associated. Two somewhat parallel bands of these rocks apparently exist in this area; the most westerly being seen in the serpentinous and dioritic masses of Melbourne, Cleveland, and Shipton, where the former portions apparently end, the diorites being continuous, however, to the little Ham mountain; the other, that seen about the Brompton lakes, where it has a somewhat extensive development and continues in the direction of Windsor Mills . . .

"Smaller areas of dioritic rocks are numerous. Of these probably the most important is seen in the township of Ascot, where it traverses the area of the copper bearing schists, extending from lot 19, range V of Ascot, southwesterly at intervals to lot 27, range IV of Hatley. This belt has a considerable development in the vicinity of some of the copper mines south of Sherbrooke. Diorites of more limited extent occur also on the line between Westbury and Stoke, but these are of comparatively recent age, since they have altered the slates with which they are in contact.

"In the Megantic area, in Clinton, Chesham and Emberton, dioritic masses are also seen. Two prominent hills are noted, the one on lots 10 and 11, range I and II of Clinton, the other on lot 25 and adjacent lots, range VII of Clinton. It is probable that the diorites of the several localities have come to the surface at widely different periods, for while some have manifestly exercised a metamorphosing action on the Cambro-Silurian strata, at other places, the lower beds of the Cambrian are largely made up of their debris."[1]

A more extended account of this area may be found in the report by Ells in Part J of the Report of the Geological Survey for 1894. A detailed description of some of the rocks of Orford mountain is given by Dresser in Part G of the Report for 1904. These dioritic hills have been more fully studied in connexion with the asbestos industry for it is in the serpentinized portions of the belts that the asbestos is found. The literature contains little or no reference to the suitability of these rocks for the production of monumental stone. My own observations at several points on the asbestos belt and in Orford mountain force me to believe that the rock is always in a shattered condition which would make the quarrying of stone for monumental purposes almost impossible. Most of the rocks examined are fine grained dark coloured stones with shades of green and brown: many of them would make desirable monumental stone if they could be quarried in blocks of suitable size.

[1] Geol. Sur. Can., Rep. 1886, pp. 39-41 J.

ORFORD AREA.

Fletcher Pulp and Lumber Co., Sherbrooke, Que. Lots 5 and 6, Range XII, Orford.

A small mass of so called granite occurs on the north shore of Webster lake and probably is not of greater extent than 100 acres. The formation is not much exposed and no work beyond a shot or two has been done. If the proposed Richmond, Magog and Stanstead railway is constructed it will pass close to this property.

The stone: No. 784.—This is a grey, medium grained rock resembling Plate LII, No. 8. It is composed essentially of black hornblende and white plagioclase feldspar. The feldspar is so badly decomposed that its reference to plagioclase is an inference rather than a determination. The hornblende is fairly fresh but in places it shows alteration to chlorite. No quartz is present and in consequence the rock is to be described as a diorite

DANVILLE AREA.

Danville Granite and Asbestos Co., F. B. Chatsey, president, Danville, Que.

The company has opened a small quarry on the above property but there has been no production in commercial quantity. The excavation is made in the side of a small hill of irregular contour.

The main joints strike southeast with a varying dip to the northeast. Numerous minor irregular joints divide the formation seriously. The stone is not uniform in grain and in places it is cut by oblique partings which are frequently filled with narrow veinlets of quartz. When free from imperfections the stone presents a pleasing dark grey colour (776).

The same belt of eruptive passes close to an opening a quarter of a mile east where the company has operated for asbestos. The formation is scarcely to be made out on account of overburden. No work has been done on the stone at this point (775).

The stone: No. 776.—This stone is of medium to fine grain and of grey colour: it is shown in Plate LII, No. 8. The constituent minerals are not sharply defined or strongly contrasted and in consequence the general effect is not brilliant. The rock contains feldspar in rather large crystals, most of which are in an advanced state of decomposition, quartz in patches composed of a large number of small quartz crystals intimately interlocked, and black mica which has been largely converted into chlorite. The feldspars are so badly decayed that their original composition is not determinable with the microscope. On the assumption that they were plagioclase, the rock becomes a quartz-mica-diorite. If the feldspars are orthoclase the rock is a granite. The corrosion test produces no visible result but there is a gain in weight which seems to be indicative, in the case of the igneous rocks, of an advanced stage of decomposition.

The physical properties are-

Specific gravity	2.686
Weight per cubic foot, lbs.	167.076
Pore space, per cent	0.358
Ratio of absorption, per cent, one hour	0.0763
" " " " " two hours	0.0856
" " " " " slow immersion	0.097
" " " " " in vacuo	0.0991
" " " " " under pressure	0.1336
Coefficient of saturation, one hour	.57
" " " two hours	.64
" " " slow immersion	.72
" " " in vacuo	.74
Crushing strength, lbs. per sq., in. dry	34,400.
" " " " " " wet	29,410.
Transverse strength, lbs. per sq. in	2,712.
Shearing strength, lbs. per sq. in	2,380.
Gain on corrosion, grams per sq. in.	0.000888
Drilling factor, mm	1.9

No. 775.—This stone resembles No. 776, but it is less uniform in structure and contains bands of chloritic or talcose matter. The broken surfaces have a "dead" appearance and suggest a diorite rather than a granite. The altered condition of the feldspar does not admit of its identification, and consequently the stone is placed here rather than with the true granites.

In this connexion the local stone at Sherbrooke may be referred to although it does not properly belong to the stones under consideration. The formation at this point consists of a contorted schistose rock which is disposed in layers of a roughly horizontal position: it is cut by numerous joints in different directions and is invaded by stringers and masses of quartz. The stone is used locally for foundations, etc.

The stone: No. 738.—A light greenish crumpled talcose schist cut by numerous quartz stringers: in places it passes into a white laminated variety. The stone is not to be classed as a building stone as it is suitable for the roughest purposes only.

NORTHERN QUEBEC AREA.

The great crystalline Pre-Cambrian area of northern Quebec contains many intrusive rocks the value of which for building purposes has never been ascertained. Numerous dykes of diabase, diorite, porphyry, and pegmatite cut the Laurentian rocks along the southern edge of the crystalline area. Basic pyroxenic rocks occur in connexion with the mica and apatite mines of Ottawa county and great masses of anorthosite occur in the county of Terrebonne and elsewhere. The granitic and syenitic masses of Rigaud mountain in Vaudreuil and the mountains of Grenville and Chatham townships in Argenteuil have already been referred to.

It is a reasonable assumption that many of the known exposures would yield material of a desirable character for purposes of construction but the inaccessible nature of a large part of this vast region would render impossible the quarrying of stone even of exceptional value. While the various reports dealing with this area mention numerous localities of occurrence and in some cases give a detailed description from the petrographic point of view, there is very little reference to the suitability of the material to decorative purposes. Attempts to quarry these dark stones have scarcely been made except in the case of the anorthosite of New Glasgow. The following notes and references will serve to indicate the chief localities in which these stones are known to occur.

Argenteuil.

Geol. Sur. Can., Rep. 1899, p. 95 J. *Diabase dykes in Petite Nation. Grenville and Chatham. Gneisses and limestones of Grenville series cut by syenites, granites, anorthosites, porphyries, pyroxenic rocks, binary granites or pegmatites and trappean or diabase rocks.*

Geol. Sur. Can., Rep. 1895, p. 136 J. *Dyke 300 feet wide of fine grained black rock allied to diabase on lot 6, range VI, Chatham Gore.*

Joliette.

Geol. Sur. Can., Rep. 1898, p. 51 J. *Diorite and pegmatite on L'Assomption river above Joliette.*

Geol. Sur. Can., Rep. 1895, p. 136 J. *Dykes of fine grained black diabase rock on range I, Augmentation of Kildare.*

Maskinongé.

Geol. Sur. Can., Rep. 1898, p. 23 J. *Large areas of anorthosite red granite, augen gneiss, and masses of green pyroxenic diabase.*

Montcalm.

Geol. Sur. Can., Rep. 1895, p. 136 J. *Dykes of fine grained black diabase on lot 16, range VII, Rawdon, and on the third, fourth and fifth ranges of Chilton.*

Ottawa.

Geo. Sur. Can., Rep. 1899, p. 57 O. *Black and very fine grained augite porphyry at Crown Hill mine, Portland township.*

Geo. Sur. Can., Rep. 1899, p. 40 G. *Numerous basic dykes in the apatite region of the Gatineau.*

Geo. Sur. Can., Rep. 1899, p. 53 J. *Diabase dykes of blackish green colour and fine grained structure from a few inches to several feet wide in Portland township.*

Geol. Sur. Can., Rep. 1899, p. 55 J. *Pyroxenite, binary granites and diorites at Emerald and Aetna mines west of the Lièvre river.*

Geol. Sur. Can., Rep. 1899, p. 57. *Fresh, coarse grained ophitic d in two wide dykes near Little Rapids mine.*

Pontiac.

Geol. Sur. Can., Rep. 1897, p. 204 I. *Mass of uralitic diabase and amphibolite three and a half miles wide on Rivière des Quinze.*

Vaudreuil.

Geol. Sur. Can., Rep. 1863. *Portion of Rigaud mountain is composed of coarse grained diorite with greenish feldspar and brilliant black hornblende.*

As far as I can ascertain none of these locations have been opened as quarries and in consequence a further description is unnecessary for this report. Incidentally it was observed that a dark eruptive stone apparently of good colour and grain for monumental work occurs to the westward of St. Jerome. This stone is described below.

The stone: No. 616. This stone is of dark, almost black colour and presents a somewhat laminated appearance: it is capable of receiving a very high polish. Under the microscope the banded structure is much more pronounced as the rock shows bands composed of plagioclase alternating with others of augite, hypersthene, hornblende, and a little black iron ore. All the constituents are in a remarkably good state of preservation. The rock is doubtless a phase of the great anorthosite mass farther north. It is however much more basic than the average of the Morin anorthosite, as the augite, hornblende and hype[illegible] make up fully a half of the microscopic section.

The stone occurs in considerable masses near St. Jerome. The dark colour, the fresh condition of the constituent minerals, and the capability of receiving a high polish should make this rock a desirable material for monumental purposes.

The great intrusions of anorthosite have been omitted from the list of localities given above but the literature makes frequent reference to these masses and they are probably of greater promise as producers of building material than the diabases, diorites and pyroxenites referred to. Areas of anorthosite occur in St. Maurice, Maskinongé, Berthier, Joliette, Montcalm, Terrebonne, and Two Mountains. The most important area covers nearly 1,000 square miles in Terrebonne and Montcalm and is known as the Morin anorthosite. A full account of this region has been prepared by Dr. Frank D. Adams and appears in Guide Book No. 3 of the Twelfth International Geological Congress. The following notes are taken directly from this publication.

"The Morin anorthosite area can be taken as a typical representative of the great anorthosite intrusions of Canada.

"The anorthosite can be considered as a variety of gabbro in which plagioclase ("anorthose") preponderates so largely that the other components sink to the rank of accessory constituents.

"The Morin anorthosite area is situated on the margin of the Laurentian protaxis 30 miles north of Montreal. The mass is about 37 miles in diameter and has a total area of 990 square miles.

"The anorthosite throughout the area is pretty uniform in composition, the chief variation being due to a somewhat uneven distribution of the constituent minerals in the schlieren which are in places developed in the rock.

"The plagioclase has been found in every case where it has been examined to be labradorite and throughout the area, except where the rock has been granulated by the action of pressure, this labradorite is filled with an infinite number of minute schillerization inclusions, which gives to it a deep violet or nearly black colour so that the massive anorthosite is always very dark.

"If any large weathered surface of the anorthosite be examined it will be noticed that the rock, which is coarse grained and of a deep violet colour, has not that regularity of structure which we see in a typical granite, but presents a more or less irregular structure. This irregularity is sometimes scarcely noticeable, but is at other times striking, and is due to concentration of the bisilicates and iron ore in some parts of the rock."

A detailed account of the anorthosites of northern Quebec is also given by Dr. Adams in Part J of the Report of the Geological Survey of Canada for 1895. The following quotation is of interest from the present point of view.

"This rock, although it has been but little used for building purposes, might in many cases be employed with advantage for decorative construction. It may be obtained in unlimited amount in the Morin area, of any colour from deep violet to white. The opalescent varieties occur but sparingly in this district. To judge of its appearance when cut and polished, two large blocks, one of the violet and one of the white variety were collected, and six inch cubes were prepared from them. These were exhibited in the Colonial and Indian Exhibition held in London in 1886. The violet variety was collected on the eastern side of range II of the township of Morin, and when polished presented a handsome appearance, but was rather dark in colour. The white variety, which was taken from the large exposure at New Glasgow, took a high polish, and in this state was found to bear a striking resemblance to marble. It is more difficult to work than marble but would be more durable and would retain its polish better, especially in exposed situations, and might well be employed for many purposes in construction.

"On account of its toughness and durability, this white anorthosite from New Glasgow has been extensively used for paving stones in the city of Montreal, especially on streets where there is a heavy traffic. A number of small quarries have been opened in the vicinity of New Glasgow, while a larger one is operated about two miles to the north of the village. The stone is blasted out in large blocks and is then dressed to the required size by means of large hammers. The industry which has sprung up is somewhat extensive; up to the time of my last visit in August, 1881, 541,000 anorthosite paving blocks having been shipped to Montreal by rail."

CHAPTER VII.

MARBLES OF THE PROVINCE OF QUEBEC.

The term "marble" in the narrow sense is confined to crystalline varieties of limestone which have acquired their characteristic structure by the metamorphic action of natural agencies such as heat and pressure. The amount of change in structure induced by these agencies is of course variable and results in rocks ranging from examples in which the crystalline structure is but slight to those in which the whole mass is converted into crystals. In this report it is proposed to include as marble all the limestones in which a secondary crystalline structure is sufficiently marked to be distinctly apparent to the naked eye, and to exclude those examples in which the crystalline structure is due to original calcareous parts of fossils or in which the secondary crystallization is but slightly advanced. This basis of classification forces us to include as marbles the product of the lime quarries north of Dudswell junction and the rocks of the cliffs at Port Daniel, although neither of these stones are likely to prove successful as decorative marbles on account of their softness.

Marble occurs under two general conditions in the province of Quebec, first, in the form of bands in the great Pre-Cambrian region of the north and in the narrower Pre-Cambrian belts of the Eastern Townships; second, in the form of metamorphosed zones in the sedimentary limestones of the Palæozoic in the Eastern Townships and in the peninsula of Gaspé. The more important occurrences under these two types will be described in the following order:

- Pre-Cambrian marbles.
  - Northern Quebec area.
    - Portage du Fort, Pontiac county,
    - Ste. Thècle, Champlain county,
    - Other localities.
  - Eastern Townships area.
    - South Stukely, Shefford county,
    - Orford mountain.
- Palæozoic marbles.
  - St. Lin, Terrebonne county,
  - Phillipsburg, Missisquoi county,
  - Dudswell, Wolfe county,
  - St. Joseph, Beauce county,
  - Port Daniel, Bonaventure county,
  - Other localities.

The marble industry is gradually becoming an important factor in the development of the mineral resources of the province. Two companies are now producing marble on a large scale, two others are entering the field, and numerous localities of possible production are receiving attention.

Marbles of Pre-Cambrian Age.

As already stated, the marbles of this age are found in the great crystalline area of the north and in the narrow belts of this age in the Eastern Townships.

NORTHERN QUEBEC AREA.

In the northern area the belts of crystalline limestone are numerous but the only places in which work is being carried on are near Portage du Fort in Pontiac county and Ste. Thècle in Champlain county. Numerous other localities are mentioned in the literature; a partial list of these is given under "other localities."

PORTAGE DU FORT DISTRICT.

White and white and blue banded crystalline limestones are exposed over considerable areas in Pontiac county north of the Ottawa river in the vicinity of Portage du Fort. The more important localities at which the stone has actually been worked are considered below:

Mrs. James Carswell, Bryson, Que.

The quarry is situated near the village of Bryson in the southern extremity of the township of Litchfield, Pontiac county. At present it is being worked on a small scale for lime burning but a small quantity of building stone has been produced from time to time. An opening of about 100 by 25 feet with a depth of 15 feet has been made on the east side of a little hill. The beds strike S. 10° W. and dip 40° to the eastward. Two types of stone are presented a strongly banded variety (639) and a variety in which the bands are less pronounced and in places absent (640). Immediately to the east is a small quarry of about the same size from which most of the stone used for building has been produced. The stone lies in beds about 2 feet thick. The formational features are the same as in the other quarry. Jointing is indistinct. The stone which is available in large quantities is described below as No. 641.

The stone: No. 640.— A grey and white banded crystalline limestone closely resembling No. 642 from the Pontiac quarry but with the banding less pronounced. The grain is coarser than in No. 642 but finer than in No. 643 from the river front at Portage du Fort.

No. 641.—A pure white stone resembling No. 643 in grain but differing slightly in the opaque white of the crystals which are less transparent than in Nos. 642 and 644.

No. 639.—A blue and white coarse grained crystalline limestone with sharply defined bands of black consisting of fine grained argillaceous matter. This is not a fine quality of stone.

The court house in Bryson was trimmed with the local stone in 1891: the white colour is perfectly preserved. Buildings constructed 50 years ago show that the stone alters to a dead white colour and loses its crystalline aspect. There is no trace of discolouration, and edges and points are perfectly preserved for the most part although some chipping may be observed.

Pontiac Marble and Lime Company, Limited; J. K. Meredith, president, 193 Sparks street, Ottawa.

The company controls parts of lots 141 and 80 in the village of Portage du Fort, Pontiac county. The quarry is opened in a belt of white marble which is estimated to extend over 100 acres.

The strike of the formation is somewhat variable but it would average about S. 30°W. with a dip of 15° to 20° northwesterly. The chief joints observed at the quarry run W. 30°S. and S. 30°E. Other joints parallel to the strike occur in the vicinity together with much surface cracking. None of the joints are so close set as to prevent the extraction of blocks of good size, but they will interfere somewhat with the easy production of stone in rectangular blocks. The bedding is heavy but somewhat irregular. The upper bed is 4 feet thick but it is divided in places by lenticular partings. The second bed is 4 or 5 feet thick and in places presents good solid stone. As surface work only has been done over an area of very limited extent, it is difficult to speak with certainty as to the solidity of the formation. It would appear, however, that as operations proceed large quarry blocks will be obtained without undue waste. The stone is a white crystalline limestone of coarse grain: much of it is pure white but other parts show a slight greenish cast. A few yellow markings and veinlets are to be seen in places. A selected sample is described below as No. 642.

About 150 yards northeast of the quarry is the old opening from which some stone was quarried for the parliament buildings in Ottawa. The stone here is of slightly finer grain.

A drill hole sunk in the floor of the quarry shows 70 feet of white stone followed by 5 feet of blue banded stone with pink veinlets (Plate XXXII).

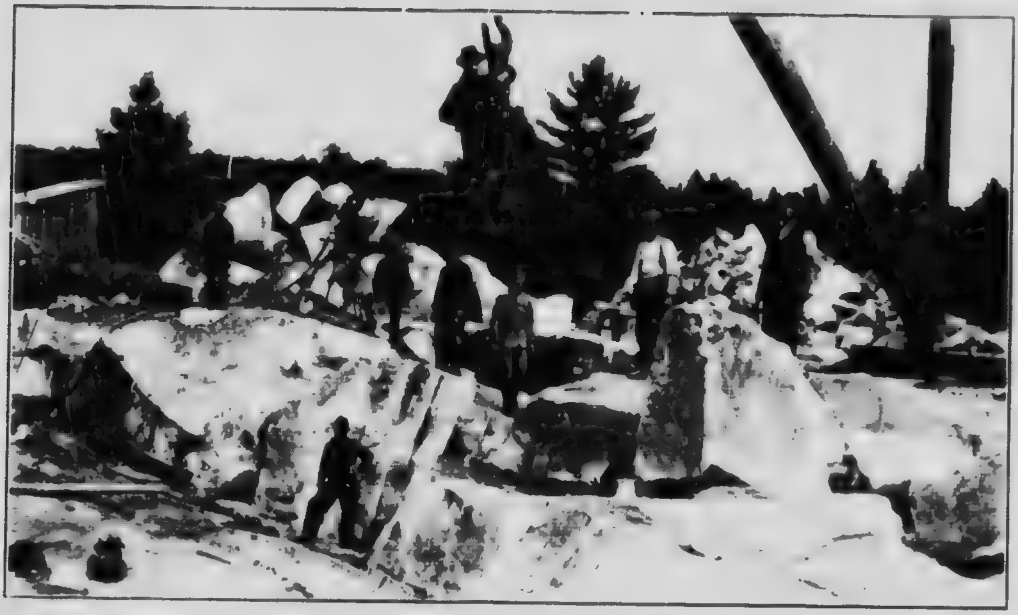
The stone: No. 642.—In the hand specimen this stone is a pure white dolomite unmarred by any flaws except the occasional occurrence of minute yellowish specks which are scarcely to be observed at a little distance. The grain is coarse with crystals up to 10 mm. in diameter. The corrosion test produces no changes apparent to the naked eye but a slight pitting of the surface may be seen with a strong lens.

The physical properties are given below. Considerable difficulty was experienced with the porosity tests and several determinations were made and rejected. The figures given are those in which no contradictory weighings were obtained.

Specific gravity	2.867 2.868
Weight per cubic foot, lbs.	178.612 178.543
Pore space, per cent	0.203 0.241
Ratio of absorption, per cent, one hour	0.0482 0.0422
" " " two hours	0.0482 0.0422
" " " slow immersion	0.0761 0.0681
" " " in vacuo	0.0761 0.071
" " " under pressure	0.084 0.071
Coefficient of saturation, one hour	.6 .6
" " " two hours	.6 .6
" " " slow immersion	.9 .95
" " " in vacuo	.9 1.00
Crushing strength, lbs. per sq. in., dry	21,850.
" " " " wet	21,850.
" " " " wet after freezing	22,210.
Transverse strength, lbs. per sq. in.	1,238.
Shearing strength, lbs. per sq. in.	1,200.
Loss on corrosion, grams per sq. in.	0.001645
Drilling factor, mm.	15.3
Chiselling factor, grams	6.0

This is a very durable stone as shown by the freezing test which gives a higher result for the frozen cube than for either the dry or wet cubes. The difference is of course to be neglected as it is well within the limits of instrumental error. The inference is that the stone is not appreciably affected either by soaking or by freezing forty times. The chiselling factor is probably too high as the slab broke under the chisel and some grains were probably lost; it would be safer to consider this factor as considerably lower.

PLATE XXXII.



Portage du Fort marble. Quarry of the Pontiac Marble and Lime Co., Portage du Fort, Que.

An analysis by Leverin gave

	per cent	
Insoluble matter	0.08	
Ferric oxide and alumina	0.32	
Calcium oxide	30.85	equivalent to 55.12 per cent carbonate of lime.
Magnesium oxide	21.04	equivalent to 43.07 per cent carbonate of magnesia

The equipment is as follows

Mill building 70 ft. by 36 ft. with an engine house, 48 ft. by 36 ft.

Producer gas engine of 105 h.p. by Grices Gas Engine Co., Carnoustie, Scotland.

One Anderson diamond saw with two 98 inch blades. The efficiency is said to be 4½ inches per minute on blocks 3 ft., 6 in. thick.

One 14 foot Anderson rubbing bed.

One boiler supplying steam to hoisting engine and one Sullivan drill.

One 15 ton derrick.

One 25 ton derrick.

The new line of the Canadian Northern railway passes close to the property. A spur 600 yards long has already been surveyed. The company is waiting for the laying of the steel before resuming operations.

Stone from this quarry has been used for monument bases and in trimming buildings. For both these purposes it seems very satisfactory. A good example of the latter application is to be seen in the residence of Mr. G. E. Reid in Portage du Fort of which the coursing stone is the blue limestone quarried in the vicinity and the trimmings are cut from the present stone (Plate XXXIII).

The inscription on the Lady Head monument erected in 1850 at Portage du Fort speaks well for the durability of the white stone as the lettering seems to have suffered no deterioration whatever.

On the company's property near the river front the crystalline limestone is traversed by wavy serpentinous bands and contorted fine grained dolomitic streaks. As no work has been done it is impossible to speak of the economic possibilities of this belt as a producer of coloured marbles.

Reid Bros, Portage du Fort, Que.

A small opening has been made to the west of the road on the small island opposite the village. The stone is the white variety but the surface is so much shattered and the old workings so overgrown with vegetation that little can be determined as to the possibility of economic quarrying.

The stone: No. 643.—This example is very similar to the white stone from the quarry of the Pontiac Marble Company. The grain however is considerably finer in this specimen.

John McCoy, Renfrew, Ont.

A small opening has been made in the island opposite Portage du Fort on the property of Mr. McCoy. The formational features are not determinable owing to the shattered condition of the surface. There is little doubt however that a uniform blue or grey crystalline limestone can be obtained in abundance as well as a variety resembling that described below as No. 644.

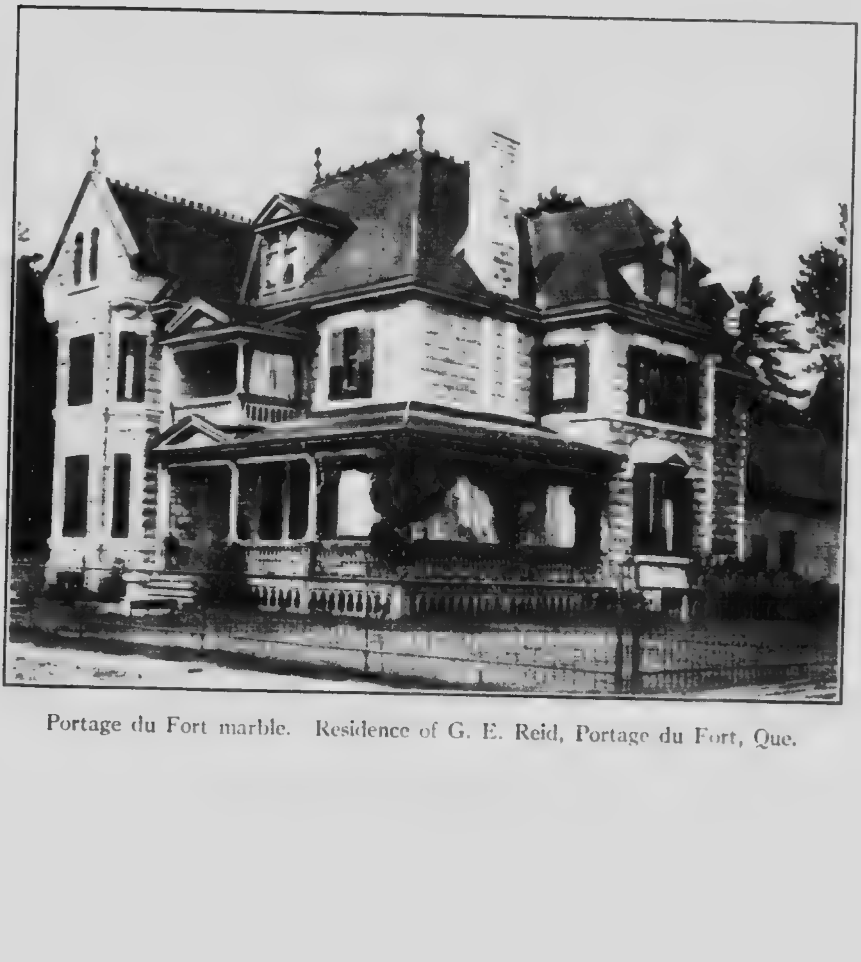
The stone: No. 645.– A coarse grained crystalline limestone of bluish colour. The fresh surface shows a mixture of white and blue crystals with dark specks. At a little distance the stone appears of a uniform light bluish colour.

In the bed of the river at Portage du Fort, the strike of the formation while generally east and west curves around in all directions. The upper shattered stone seems to have been removed by erosion leaving the formation in a condition of much greater solidity. There is no doubt that large quarry blocks could be procured here. The stone is of a banded type in which the bands seem to be due to different degrees of dolomitization. This stone as representing typically the banded type of crystalline limestone is described in detail below.

The stone: No. 644. This stone is a medium grained crystalline limestone showing bands of white and blue. The blue colour is probably due to the presence of minute grains of graphite. The corrosion test produces a perceptible effect as the stone is whitened and shows etching over the surface.

The physical properties are:

Specific gravity	2.739
Weight per cubic foot, lbs.	170.426
Pore space, per cent.	0.216
Ratio of absorption, per cent, one hour	0.0492
" " " " " two hours	0.0523
" " " " " slow immersion	0.0685
" " " " " in vacuo	0.0727
" " " " " under pressure	0.0762
Coefficient of saturation, one hour	.64
" " " two hours	.68
" " " slow immersion	.89
" " " in vacuo	.95
Crushing strength, lbs. per sq. in., dry	21,200.
" " " " " " wet	20,800.
" " " " " " wet after freezing	16,800.
Transverse strength, lbs. per sq. in.	2,325.
Shearing strength, lbs. per sq. in.	1,490.
Loss on corrosion, grams per sq. in.	0.02808
Drilling factor, mm.	9.
Chiselling factor, grams	8.1



Portage du Fort marble. Residence of G. E. Reid, Portage du Fort, Que.

Great difficulty was experienced[1] in obtaining duplicate results in the porosity tests. The figures given above have been selected from a number of experiments. The variations occurred chiefly with the short immersions; in the case of the total water absorbed the results were in all cases approximately as given.

STE. THÈCLE DISTRICT.

La Compagnie de Marbre du Canada, Eugene Leclerc, 88 Rue St. Pierre, Quebec, Que.

This company controls lots 200, 201 and 212, range B North, Price seigniory, parish of Ste. Thècle, Champlain county.

On this property a band of crystalline limestone occurs between grey mica gneisses of the Grenville series. Mr. Denis states that the belt has a length of 1000 ft. and a width of 200 ft.

The gneisses show numerous intrusions of coarse reddish granite. They have an indistinct and variable strike of about N. 30° W. and a low and varying dip to the northeast. The normal crystalline limestone is white and coarse grained and is more or less interbanded with the gneisses (912). Further the limestone is associated with a basic dark coloured igneous rock which occurs in blebs and streaks throughout the formation. Near the igneous masses the limestone has assumed a distinct red colour (913) for the most part, but in some places the effect has been to induce a streaky green colour (914).

The opening is about 40 feet by 30 feet and 12 feet deep. It has been made by a channeller and consequently presents clean walls. The walls and the blocks removed all show the presence of the dark basic bands and blebs. It is a curious and unusual feature that these basic blebs are coarse grained at their margins and of much finer grain towards the centre. Some inclusions of reddish syenitic rock were also observed in the walls of the quarry. There is a remarkable absence of jointing in the formation and blocks of a large size can undoubtedly be quarried. The unfortunate features are the coarse grain of the stone and above all the presence of the basic, dark coloured inclusions already referred to.

A substantial mill and several other buildings have been erected. The mill is provided with an engine and boiler, two Patch gang saws, and a rubbing bed. The necessary tracks and transfer cars are also provided. A good derrick and a small channelling machine are installed in the quarry. The haul to the railway at Ste. Thècle is about three miles.

The stone: No. 912.—A pure white crystalline limestone of coarse grain—even coarser than No. 642 from Portage du Fort from which the present stone may be distinguished by its slightly salmon-coloured cast in places.

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[1] Dept. Col. Mines and Fisheries, Que., Rep. Mines Branch, 1912, p. 43.

No. 913.- A light pink to salmon-coloured crystalline limestone of even grain and of considerably finer structure than No. 912. An analysis by Leverin gave:-

	per cent.	
Insoluble matter	0.36	
Ferric oxide and alumina	0.26	
Calcium oxide	54.15	equivalent to 96.69 per cent carbonate of lime.
Magnesium oxide	1.24	equivalent to 2.59 per cent carbonate of magnesia.
Combined water	.58	

No. 914. A white medium grained base with flakes of glistening amber-coloured mica; in places are inclusions of black basic rock rich in hornblende or augite. Surrounding these inclusions the limestone is pink for a short distance and beyond is tinged bright green. The green diminishes in intensity away from the inclusions and fades into the white of the matrix.

No. 915. A coarse grained pink crystalline limestone with numerous crystals of amber-coloured mica. The stone is blotched with white and contains inclusions of basic rock in an altered condition.

No. 916.- Resembling No. 915 but is more banded with white and contains large basic inclusions and scattered crystals of mica.

Other Localities of Occurrence of Marble in the Northern Pre-Cambrian Area.

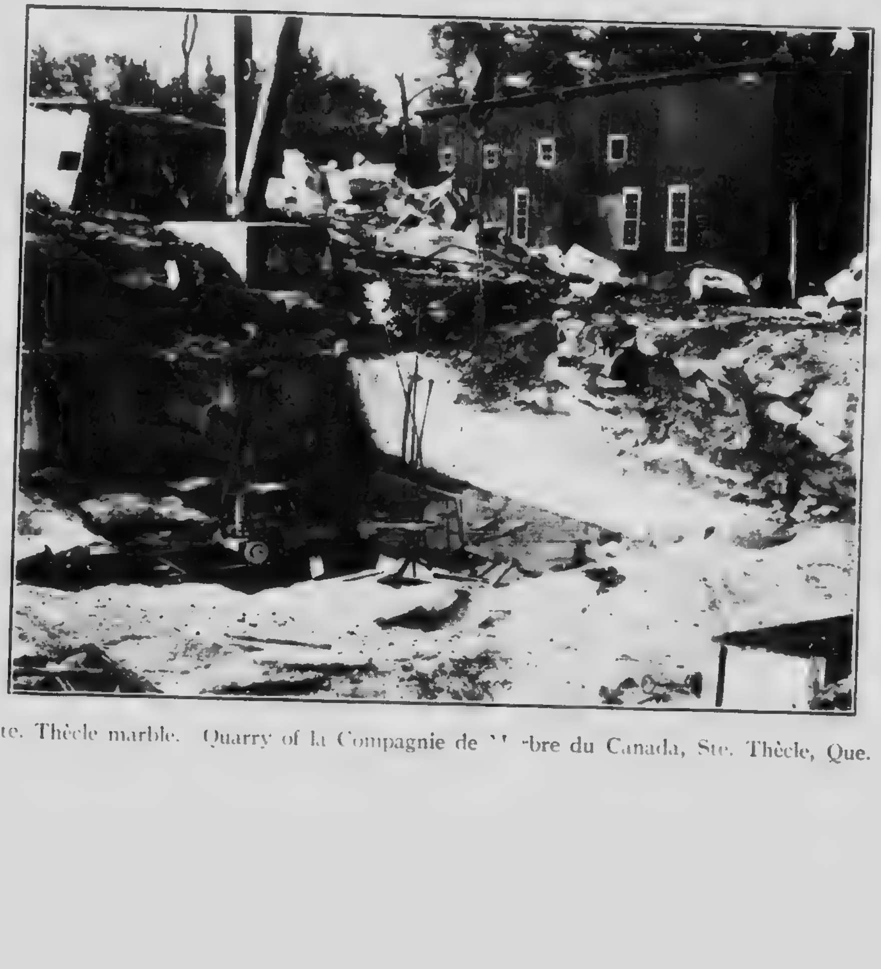
The great Pre-Cambrian region of northern Quebec contains bands of crystalline limestone throughout the region from Château Richer below Quebec to the Black river in the county of Pontiac. Most of these bands are undoubtedly too impure or too coarse to be of value for decorative stone and with the exception of those already mentioned scarcely any attempt has been made to work them. A clear understanding of the distribution of these bands may be gained from the following maps of the Geological Survey of Canada:—the Three Rivers map sheet, the Quebec map sheet, the Montreal map sheet, the Grenville map sheet, and the Pembroke map sheet.

The following list of references to the more important occurrences may be found useful but it is to be understood that it is not proven that any of them contain stone suitable for decorative purposes. As all these references are taken from the reports of the Geological Survey of Canada, the year to which the volume belongs is alone given.

Argenteuil.

1895, p. 139 K. *On lot 10, range V, Grenville, white crystalline.*
1899, p. 10 J. *Numerous bands of crystalline limestone.*

PLATE XXXIV



Ste. Thècle marble. Quarry of la Compagnie de Marbre du Canada, Ste. Thècle, Que.

1899, p. 18 J. *Quarry in whitish grey crystalline limestone opposite Lachute on north side of North river. One band 10 feet wide.*

Rough and contorted on ranges III, IV, and V, Chatham Gore.

1899, p. 21 J. *Small mass near Lakefield. One mile south of Sir John lake and other localities.*

1899, p. 22 J. *Long and important bands described in Chatham, Wentworth, and Grenville.*

1899, p. 25 J. *Large band in Harrington.*

1899, p. 26 J. *Range V, Harrington; Marble Falls on Rouge river.*

1899, p. 50 J. *Bands in Montcalm and Wentworth townships.*

1899, p. 136 J. *Quarries rare north of Ottawa river. Quarry opposite Lachute.*

1888-89, p. 127 K. *Lot 16, range III, Grenville, marble plant erected. Occurs with serpentine at Grenville, St. Andre Avelin and the Augmentation of Grenville.*

Berthier.

1898, p. 55 J. *Bands in Berthier.*

Champlain.

1887-88, p. 31 A. *Parish of St. Tite, three bands, one is a fine grained rose coloured variety capable of high polish.*

1885, p. 54 A. *Band from Cap Tourmente to parish of St. Tite.*

Chicoutimi.

1885, p. 26 D. *Greyish green on fifth lake of Lake Manouan portage route.*

1898, p. 117 A. *Township of Polette.*

Joliette.

1895, p. 152 J. *A quarry was opened for marble between lots 8 and 9, range VI, Cathcart. Abandoned on account of coarse grain and bands of impurities.*

1895, p. 24 J. *Ranges VII and VIII, Cathcart; lot 11, range IV, Cathcart; ranges III and IV, Augmentation of Kildare; lots 27 and 28, range XI, Cathcart; lot 28, range II, Cartier and northward. Best at St. Come. Large exposure one and a half miles west of St. Alphonse on range I, Cathcart, and at intervals north to range IX. Thin and impure on Range VII, Kildare; in seigniory of D'Aillebout and on ranges III and IV, Joliette. Lot 2, range VII, Kildare and in D'Argenteuil one mile east of town line of Kildare.*

1895, p. 152 J. *Burned for lime near St. Come and on lot 23, range IX and lot 27, range XI, Cathcart.*

1398, p. 55 J. *Numerous bands in Joliette.*

Maskinongé.

1892-93, p. 47 A. *Impure on Lacroix creek.*

Montcalm.

1895, p. 152 J. *Limekilns on lot 28, range X and lot 28 range XI, Rawdon.*

1895, p. 151 J. *Lime burned from course crystalline bluish white limestone from islands on the west side of Lake Ouareau.*

1895, p. 24 J. *Lot 10, range VII, Kilkenny; lot 20, range II, Lussier; Lake Ouareau; ranges VIII and IX, Rawdon. Large exposure on ranges IX, X and XI, Rawdon; best on range IX.*

1898, p. 55 J. *Bands in Montcalm.*

1894, p. 103, J. *Fine white on lot 10, range VII, Kilkenny. Heavy band in Rawdon.*

1887-88, p. 27 A. *On Ouareau lake.*

1887-88, p. 85 A. *At St. Alphonse.*

Montmorency.

1863, p. 46. *Falls of St. Féréol, Ste. Anne river.*

1890-91, p. 21 L. *At Château Richer, highly crystalline and flesh red to pink and greenish white.*

Ottawa.

1904, p. 239-250 A. *Numerous references to bands in the southern part of the county.*

1899, p. 103 J. *In Hull and Templeton.*

1904, p. 230 A. *In Hull.*

1909, p. 235 A. *In Templeton.*

1899, p. 11 J. *Bands in Masham, Cawood, Aldfield, Low, Aylwin, Wright, Bouchette, and Maniwaki.*

1888-89, p. 127 K. *Quarry on lot 18, range VIII, Hull.*

1899, pp. 32-76 J. 126 J. *Very numerous and wide bands between the Gatineau river and the eastern boundary of the county, particularly in Petite Nation, Buckingham, Lochaber, Ripon, Mulgrave, Hull, Portland, Wakefield, Blake, McGill, and Bigelow.*

Pontiac.

No. 977, 1907, p. 6. *Most westerly exposure one mile beyond Black river. Large deposits west of Gatineau river and in the eastern part of the county.*

1894, p. 61 A. *Large deposit on island below Galetta island in the Ottawa river.*

1895, p. 66 A. *Most westerly deposit on post road two miles west of bridge over the Black river.*

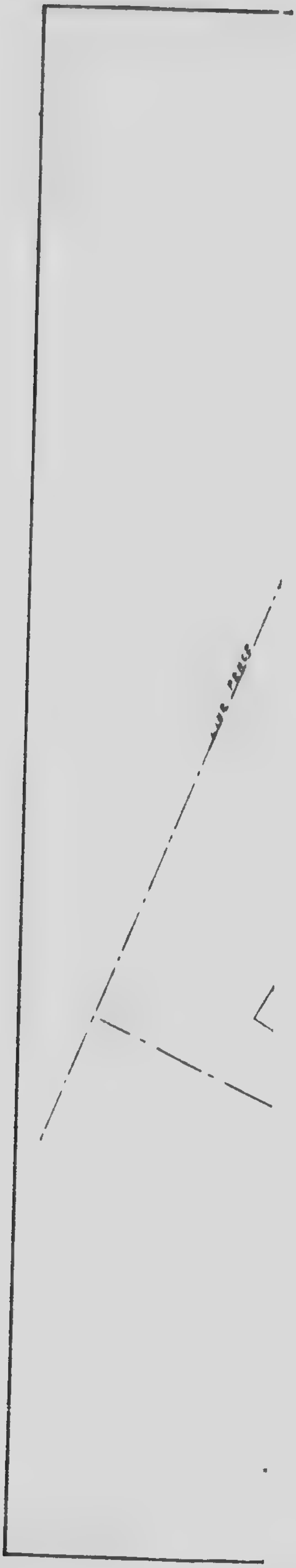
1895, pp. 54-55 A. *Bands on the lower 40 miles of the Black river.*

Saguenay.

1895, pp. 184 and 242. *On Manikuagan river.*

1895, pp. 104 A, 183 and 241 L. *On Mushalagan river.*

1885, p. 11 A. *On Bersimis river.*



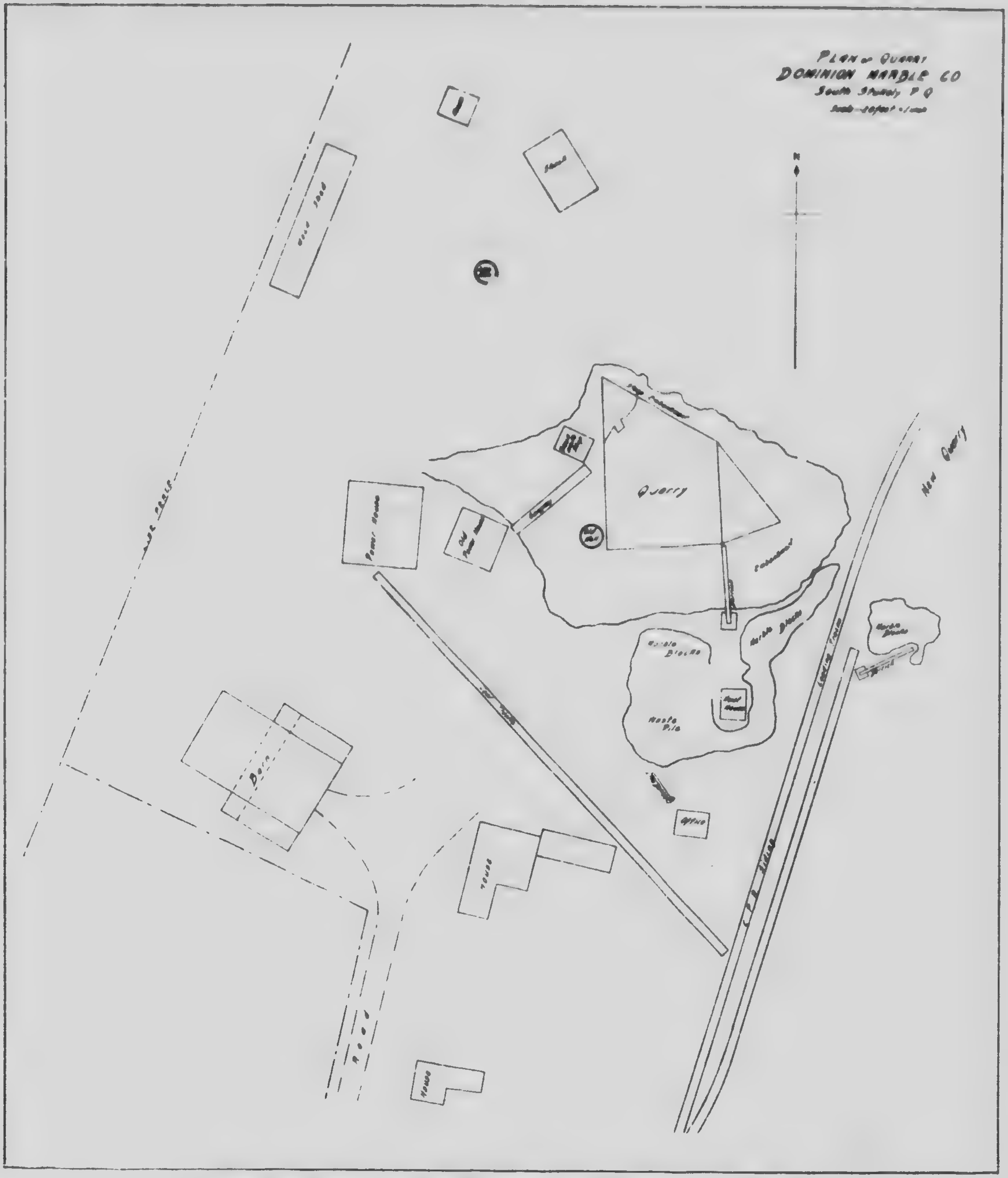


Fig. 8. Plan of the property of the Dominion Marble Co. at South Stukely, Que.

St. Maurice

1895, p. 43 A. *White crystalline micaceous on Matawin*

1888-89, p. 35 A. *On Mattawin river*

Terrebonne

1895, p. 151 J. *Coarsely crystalline bluish white stone used for lime near St. Saveur. Burned for lime west of St. Jovite in the township of De Salaberry*

1895, p. 22 J. *Small outcrop on the west side of North river near St. Jerome.*

1895, p. 23 J. *Large deposit west of New Glasgow extending to range III. Kilkenny in Montcalm*

1894, p. 100 J. *On Tremblant lake*

1899, p. 20 J. *At St. Saveur and Morin.*

1899, pp. 26, 28 J. *Band 250 yards wide at St. Jovite*

1894, pp. 102, 103 J. *Coarsely crystalline almost white at St. Saveur Augmentation of Mille Isles St. Jerome, and New Glasgow*

EASTERN TOWNSHIPS AREA.

The only quarry in actual operation in this area is that of the Dominion Marble Company at South Stukely. Other openings have been made in this district but none of these are now producing stone for building or ornamental purposes.

Pre-Cambrian limestone is found in Orford mountain and has there been worked for marble. With the exception of this locality and an occurrence in South Ely, the literature contains no references of economic importance

SOUTH STUKELY DISTRICT.

The Dominion Marble Co., Limited, R. T. Hopper, president, Montreal; R. Jackson Hopper, secretary-treasurer, P.O. Box 1166, Montreal; Henry Brown, superintendent of quarry, South Stukely, Que.

The quarry property of this company consists of 183 acres in the second range of South Stukely, Shefford county. The quarry is on lot 8, range II. The company's mill is at Turcot, Montreal.

The excavation has been made on the site of an old quarry which had been worked for lime burning for a period of thirty years. The formation belongs to the old crystalline series, for the marble belt is bounded on both sides by crumpled mica schists. The strike of the belt is N. 40°E. with a vertical dip on the southeast side but inclining outwards at a high angle on the northwest side. The proved width of the valuable stone is about 160 feet and its length one and a quarter miles.

The succession of beds across the quarry from the southeast to the northwest is given below in a general way but there is considerable variation, particularly in the occurrence of the violet-tinted varieties.

15 ft.—A yellow mottled variety in dark (736) and light (841) tints—dark and light "Jaune royal."

10–12 ft.—A pink mottled banded and veined type in dark (846) and light (845) tints—dark and light "Rose royale."

15 ft.—White marble clouded with pink and green in light and dark shades. The dark green clouded type is called "Vert royal" (737) the lighter green, "Light vert royal," and the pink clouded variety is known as "Violetta" (842).

13 ft.– A light blue clouded type known as "Royal veined white" (844).

. . . . . .Limit of deep quarry.

30 ft.– A darker blue type, "Royal Dominion blue" (843).

The present quarry has been opened over a smaller area within the old excavation made for lime burning. The quarry does not conform to the strike of the formation but has been opened in a north and south direction with the western face 85 feet long and the eastern 50 feet long. The southern wall is at right angles to the sides but the northern end is inclined. Over this area three courses of 4 ft. 6 in. each have been removed. Two more courses of 7 ft. 6 in. each have been taken out in the southern part of the quarry over an area 55 feet square. (Fig. 8).

A second opening has been made at a point 80 feet along the strike from the southeast corner of the quarry. This excavation is 75 feet in length along the strike and about 30 feet wide. The stone here is light jaune royal so little fractured that good mill blocks have been obtained from the surface (Plate XXXV).

The most pronounced jointing in the larger quarry is at right angles to the strike but with increasing depth it is found that the joints have practically disappeared. The only partings now encountered are local and of limited extent. Practically the whole of the stone from the deeper courses is capable of making mill blocks. Good solid slabs of vert royal have been cut, 8 ft. by 4 ft., and slabs of jaune royal up to 11 feet in length by 6 feet wide.

The stone: No. 736.—Dark jaune royal is a fine grained marble delicately veined and spotted with shades of yellow. Through this groundmass more pronounced veinlets of darker yellow and green tints are scattered irregularly. Considerable pyrite is present in places but in others this mineral is practically absent. Under the corrosion test the surface becomes pitted and deadened and presents a minutely speckled effect.

The physical properties are as follows:

Specific gravity	2.781
Weight per cubic foot, lbs	173.050
Pore space, per cent	0.323

Plate XXXV.

South Stukely marble. Cutting marble blocks from surface at the quarry of the Dominion Marble Company, South Stukely, Que.

South Stukely marble. Polishing machines in mill of the Dominion Marble Co., Côte St. Paul, Montreal.

Ratio of absorption, per cent, one hour	0.068
" " " two hours	0.0763
" " " slow immersion	0.1167
" " " in vacuo	0.1167
" " " under pressure	0.1167
Coefficient of saturation, one hour	.58
" " " two hours	.65
" " " slow immersion	1.00
" " " in vacuo	1.00
Crushing strength, lbs. per sq. in., dry	17,450.
" " " " wet	16,520.
" " " " wet after freezing	15,580.
Transverse strength, lbs. per sq. in	3,115.
Shearing strength, lbs. per sq. in	1,665.
Loss on corrosion, grams per sq. in	0.019
Drilling factor, mm	13.4
Chiselling factor, grams	6.8

An analysis of this marble gave Leverin the following result:—

	per cent	
Insoluble matter	12.20	
Ferric oxide and alumina	2.40	
Calcium oxide	45.35	equivalent to 80.93 per cent carbonate of lime.
Magnesium oxide	1.38	equivalent to 2.91 per cent carbonate of magnesia.
Combined water	1.50	

No. 841.—Light jaune royal is of a lighter yellow colour than the preceding and shows the yellow clouding in a more banded manner. The darker yellow and greenish veinlets are practically absent but the stone is traversed by light, brownish grey to pink, irregular bands which are roughly parallel to the banding. This material is of exceedingly fine grain. Occasional narrow bands of pure white calcite of coarser grain are to be seen. No pyrite was observed in this specimen (Plate XXXVII).

No. 846.—Dark rose royale consists of an exceedingly fine grained base varying from a light rose colour to a pinkish chocolate. This base is clouded with white and veined and spotted very delicately with chocolate colour. The whole is traversed by veinlets of white calcite. This is a very handsome and striking marble.

No. 846.—Light rose royale consists of a white, fine-grained base slightly clouded with yellow in which rose coloured clouds appear at intervals. The general appearance of the marble is also affected by the presence of white blotches of slightly coarser grain. Light rose royale is a very handsome and delicate marble suitable for drawing room decoration, etc.

No. 737. Vert royal is of coarser grain than the preceding marbles but it is not coarse compared with ordinary crystalline limestone. The polished surface is practically all green in clouds and bands of different shades. A considerable amount of pyrite is present (Plate LI, No. 15).

No. 842. Violetta is a clouded marble in green, white, rose and chocolate colours. The handsome appearance is increased by the presence of fine lines of brilliant golden yellow colour which cut through the rock in a reticulating manner (Plate XXXVIII).

No. 844. Royal veined white is a marble of fine to medium grain with a brilliant and glistening surface when polished: it is irregularly banded and clouded with a dark grey colour which is generally called "blue" in the case of marbles. This stone is of colder appearance than any of the preceding but it is nevertheless a handsome marble closely resembling the Vermont clouded types.

No. 844.—Royal Dominion blue is of the same class as "Royal veined white" but much more of the blue component is present and the contrasts between the blue and the white are more sharply defined. In places the grain is rather coarse and the dark portions carry a considerable amount of pyrite.

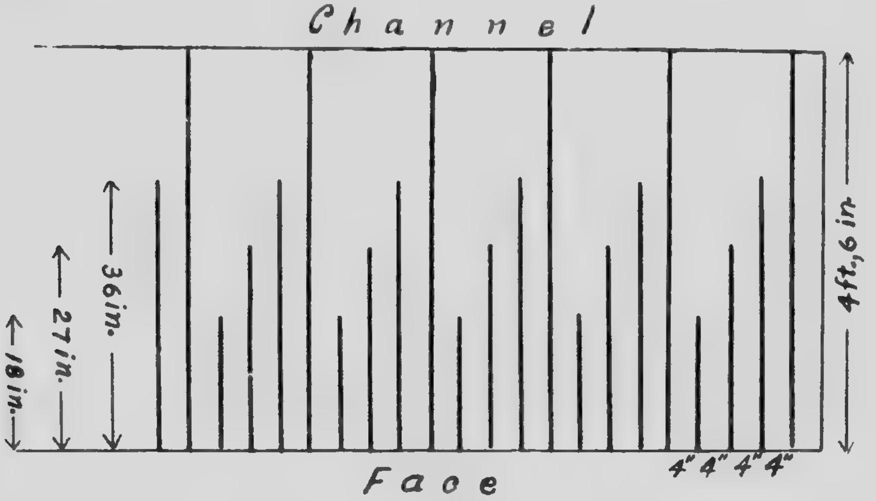


Fig. 9. Arrangement of gad holes for raising blocks in the South Stukely quarries.

The method of quarrying now used is as follows:

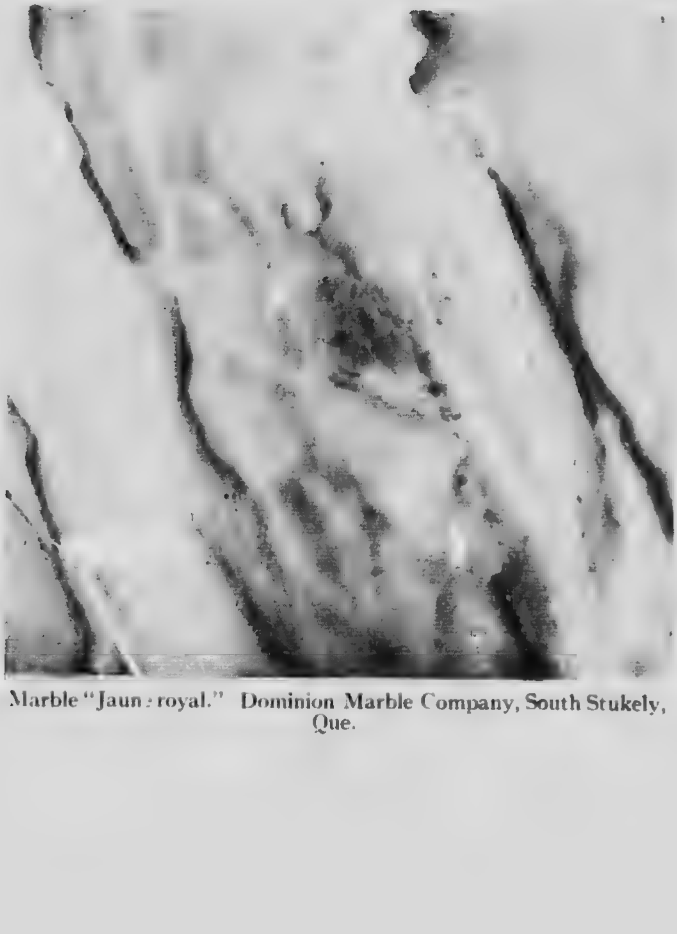
1st. A channel is run all around the walls to a depth of 7 ft. 6 in. In order to increase the size of the quarry these cuts incline outwards: on the east and south walls at 60° and on the west wall at 40°.

2nd. Three channels are run at intervals of 4 ft. 6 in. to a depth of 7 ft. 6 in. across the middle of the floor at right angles to the strike.

3rd. The two strips are cross channelled at intervals of 4 ft. 6 in.

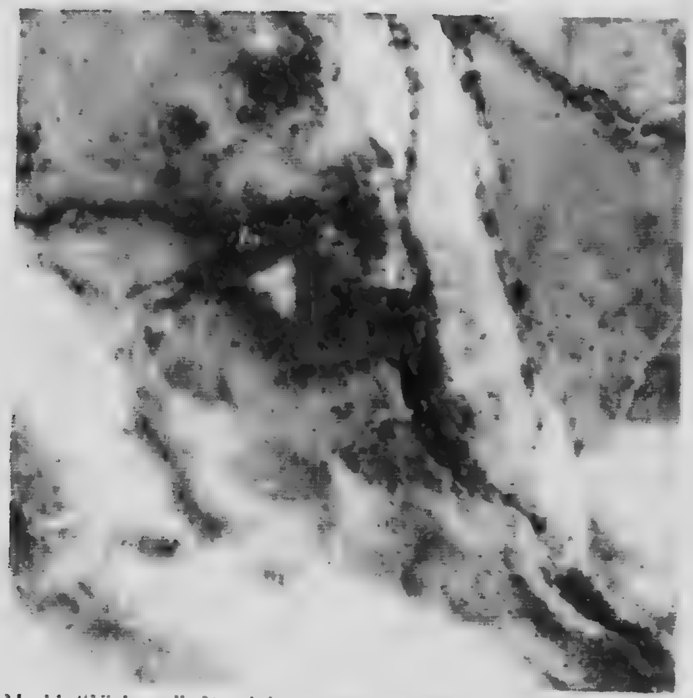
4th. Two or more blocks are broken off by wedges in the channels and lifted out.

Plate XXXVII.



Marble "Jaune royal." Dominion Marble Company, South Stukely, Que.

Plate XXXVIII.



Marble "Violetta." Dominion Marble Company, South Stukely, Que.

5th. The rest of the blocks are raised by gadding and removed.

6th. The floor on both sides of the long cut, i.e. across the strike, is channelled at intervals of 5 ft. 6 in.

7th. The strips thus produced are cut into blocks according to colour by gadding from the face. They are raised by gadding and wedging.

Mr. Brown favours the method shown in the accompanying sketch for raising blocks by gadding.

The equipment of the quarry consists of the following apparatus besides minor appliances:

Three 150 h.p. boilers, Goldie and McCulloch, Galt, Ont.

Four channellers, No. 6½ Sullivan swivel head. Working on direct steam these machines average 40 sq. ft. per day of 10 hours.

One small channeller, Sullivan V.X.,

One gadder with drill,

One tripod drill,

Two 12 ft. quarry bars with drills,

One 90 h.p. engine directly connected to an Allis-Chalmers dynamo for lighting and pumping.

One 35 ton steel frame derrick, Pollard Manufacturing Co., Niagara Falls, Ont.,

One steam hoist of 50 tons capacity by Jenckes Machine Co.,

One 20 ton derrick with steam hoist,

Two smaller derricks for loading, etc.

The quarry is connected with the C.P.R. by a spur 1¼ miles long. Thirty men are employed. The production in 1912 was 30,000 cu. ft. and a larger output is anticipated for 1913.

The mill is located at Turcot, Côte St. Paul, Montreal. The property consists of 45,000 square feet conveniently located near the Lachine canal and furnished with sidings from both the Grand Trunk and Canadian Pacific railways.

The mill building is 163 feet long by 133.9 feet wide. A second storey, 121 feet long and 35 feet wide, extends along the northern face of the building: this portion contains the offices and the finishing shops.

Power is obtained from the Montreal Light and Power Company, about 150 h.p. being used in the mill and 45 h.p. to operate an electric crane. One 75 h.p. motor by the Allis-Chalmers-Bullock Company (Rating 75 h.p., Volts 550, R.P.M. 600, Phase 3, Cycles 60, Amperes 75) supplies power to the workshops and another of the same type operates the gang saws and the ventilating apparatus. An Allis-Chalmers-Bullock transformer reduces the current to 240 volts for the crane (Volts 240, K.W. 275, Amperes 104½).

The gang plant consists of six saws set on particularly heavy concrete foundations 12 feet deep. The saws are by the Lincoln Iron Works and are of the single pitman type in the following sizes:

Three saws 5 ft. 6 in. wide and 9 feet long.
One saw 5 ft. 6 in. wide and 10 feet long.
One saw 5 ft. 6 in. wide and 12 feet long.
One saw 7 ft. 6 in. wide and 9 feet long.

The saws are operated at 90–100 strokes per minute. Working with 40 blades on blocks of Stukely marble 9 feet long the efficiency is about 9 inches in 12 hours. The saws are equipped with Frenier pumps and distributors. A good grade of sand is obtained from Joliette. The present building is capable of containing six more saws.

The finishing plant consists of:—

Three rubbing beds, 10 ft., 12 ft., and 14 ft., Lincoln Iron Works: these are operated at 40 revolutions a minute.

Two polishing machines (more being installed) (Plate XXXVI).

One carborundum machine, Patch Manufacturing Co.,

One lathe,

One 40 h.p. electric crane, Dominion Bridge Co. (Length, 150 ft. to be extended to 250 ft.; span, 50 ft.; main hoist, 40 tons; auxiliary hoist, 5 tons.)

One compressor delivering air at 80 lbs. per sq. in. to 50 pneumatic stations.

It is proposed to install another crane to handle material in the slab yard. The company employs an average of 50 men the year round.

South Stukely marble may be seen in the following buildings:—

Château Laurier, Ottawa—Jaune royal, Violetta.
Bank of Ottawa, Regina—Vert royal.
Henault apartments, Bishop street, Montreal—Vert royal.
Y.M.C.A. building, Brantford, Ont.—Rose royale, Royal veined white.
Tremont house, Yonge street, Toronto—Royal Dominion blue, Rose royale.
Union Bank, Metcalfe street, Ottawa—Violetta.
Canadian Pacific Railway offices, Toronto—Light jaune royal.
Confederation Life building, Winnipeg—Royal Dominion blue, Royal veined white.
Standard building, Montreal—Light jaune royal.
St. Pierre building, Union avenue, Montreal—Royal veined white.
Gravel building, Montreal—Jaune royal.
Royal Bank ,Saskatoon—Light jaune royal, Vert royal.
Builders exchange, Montreal—Exhibit of Light rose royale, Vert royal, Royal veined white, Light jaune royal, Royal Dominion blue and Violetta.

The following prices are selected from the company's price list of 1912.—

Sawed stock, not sand rubbed or crated, per sq. ft.

	⅞ in.	1¼ in.	1½ in.	2 in.
Rose royale Jaune royal Violetta Vert royal	$ .80	$1.00	$1.30	$1.60
Royal Dominion blue	.50	.63	.75	1.00
Royal veined white	.35	.44	.52	.70

Crating, per sq. foot.

Slabs 2 in.	$ .10
Slabs 1 in., 1¼ in., and 1½ in. singly	.08
two or more together	.05

Finished work, slabs 7/8 in., pointed to size, polished one face and boxed, per sq. ft.

Jaune royal Light jaune royal Rose royale Light rose royale Violetta Vert royal	$1.50
Royal Dominion blue	$1.20
Royal veined white	.75

The company also quotes on floor tiling, floor border, bases, capping, treads and platforms and special work of all kinds.

M. D. Beaugard, Ste. Anne de Stukely, Que.; Lot 13, Range VII, North Stukely.

The quarry is situated two and a half miles from Ste. Anne; it has long been worked for lime and it has also produced a considerable amount of building stone.

The formation strikes N. 40°E., and dips 70° to the northwest. The southeast country rock is a green schist highly ferruginous and contorted, with included blebs of quartz and a large amount of pyrite. The marble belt has a proved width of 150 feet but it may be much wider. The jointing is irregular in both a north and south and an east and west direction; in places it is excessive but owing to the use of dynamite the amount of natural jointing is difficult to determine.

The prevailing colour of the stone is light and bluish and the texture is of even and medium grain. Strips of darker blue (725) and of white occur throughout the formation; in places these strips are so close together that they produce a blue and white banded rock (727). A blue variety veined with white is seen in places (726) while in others the veining is green and yellow (728). Considerable pyrite is present in certain parts of the quarry.

The stone: No. 726.—A fine grained whitish marble banded with grey. The bands are broad and ill defined giving a greyish clouded effect to the whole stone.

No. 725. A very fine grained marble like No. 726 but with a blue rather than a grey tone. The general effect is bluish with clouds of white.

No. 727.—A medium to fine grained marble showing bands of grey, white and yellow. The grey and white are in broad bands but the yellow occurs in narrow and sharply defined lines parallel to the general banding of the rock.

No. 728.—A medium grained marble with clouds of grey and green and with fine veinlets of yellow traversing the general mass. This is a rather handsome variety.

While the quarrying of stone for lime making is the chief object of present operations, in the past considerable stone has been raised for building purposes. The chief structure in which the product has been used is the church of Notre Dame de Bonsecour near North Stukely. This building, erected in 1878, shows that the stone retains its edges well and that the sharpness of the chisel marks has scarcely been affected. Viewed from a little distance the whole building presents a light and uniform appearance. When examined more closely, however, the bluish and veined character of the stone is apparent. Pyrite is quite conspicuous in certain blocks but it seems to have been scarcely affected as little or no staining is yet to be seen. Some blocks are badly off colour due to setting up the stone with a joint plane for face. The rejection or trimming down of a comparatively small number of blocks would have improved the appearance of the building.

ORFORD MOUNTAIN DISTRICT.[1]

J. Minard, North Stukely, Que; Lots 10, 11 and 12, Range A. F., Orford.

The belt of marble on this property of 115 acres appears to be about 100 feet wide: it is of very irregular shape and lies between greenish schistose rocks (730). The strike is east and west and the dip vertical. The natural jointing can scarcely be made out as the exposure and workings are in the side of a bluff near a small creek where the influence of surface agencies has been excessive.

The marble band is very irregular with large inclusions of the country rock. Speaking broadly two types of stone are presented—a red (732) and a green (733). These two varieties are not in the form of parallel bands but are irregularly distributed, the red type appearing at different levels in the hillside. There is evidence of strong metamorphism with a secondary introduction of white calcite veins into the red marble. Masses of needle-like green actionlite and crystals of green calcite are developed in places.

Work was begun on the deposit in 1905 and a dam was erected with the intention of using the creek for the production of power. A few blocks were quarried and I am informed that Mr. H. Brown, now manager of the Dominion Marble Company's quarries, obtained some blocks of the red stone, 4 ft. by 3 ft. by 2 ft., which were sawn into slabs for use in the Parliament Building, Ottawa. The red stone is a very handsome material but insufficient work has been done to establish its extent or the possibility of quarrying it on a commercial scale. The long haul to the rail is a factor to be considered.

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[1] It is not certain that this district should be ascribed to the Pre-Cambrian.

The stone: No. 732.- A fine grained reddish crystalline limestone cut by veinlets of white calcite and traversed by parting planes in which a small amount of altered basic minerals occur. In many places these darker lines show sericite and when they are larger seem to be composed of greenish actinolite. The general appearance of the polished surface is shown in Plate LII, No. 11 but the relative amounts of red and white vary greatly in different places. This is a very handsome marble and highly desirable on account of the depth and richness of the red colour.

No. 733. The green variety differs from the red in that the green component which is quite subordinate in No. 732 is here so abundant that the red colour is seen in spots only. The white veinlets are strongly developed. The stone is a mixture of white calcite and green actinolite in needles with a less amount of fine grained red calcite in places.

No. 730.—Altered basic rocks of a greenish colour rendered schistose by metamorphism. In places, particularly near the marble bands, masses of radiating actinolite of a light green colour may be obtained.

The red marbles from Trenholm on the St. Francis river, from St. Joseph on the Chaudière and from the present location in Orford mountain differ only in detail. They are all very handsome stones but the commercial possibilities are questionable in each instance.

Metamorphic Marbles of Palæozoic Age.

The stratified limestones of the Palæozoic have been rendered crystalline in places by metamorphic agencies and thus have been converted into true marbles. Marbles of this type are found in the Eastern Townships in formations of Cambrian, Ordovician, and Silurian age. The more important occurrences are at Phillipsburg and in the township of Dudswell. Rocks of this type also occur at St. Lin in the county of Terrebonne and in the peninsula of Gaspé. It will therefore be convenient to describe the Palæozoic marbles under the following areas:

St. Lin area,
Missisquoi area,
Dudswell area,
St. Joseph area,
Port Daniel area,
Other occurrences.

ST. LIN AREA.

The deposit of marble at St. Lin in the county of Terrebonne does not seem to have much economic importance and it was not visited for the purposes of this report. The following description by Ells contains all the necessary information.

"Another marble, quite different in character and age, occurs about a mile from St. Lin, on the road to New Glasgow. The rock belongs to the Chazy formation and is exposed where a small tributary of the L'Achigan river cuts through the drift and lays bare the underlying rock. The marble is produced by the alteration of the Chazy limestone by an intercalated sheet of trap which occupies the bed of the stream. It is red in colour and forms a thin layer over the traps. The marble has been quarried to a limited extent, but work had been suspended at the time of my visit.[1]

MISSISQUOI AREA.

The general geology of this region has been discussed at length in various reports of the Geological Survey of Canada to which the reader is referred.[2] It would appear that there is a very extensive belt of limestones belonging in all probability to the Chazy formation which has been rendered crystalline by metamorphic agencies. The whole belt is not sufficiently crystallized to constitute a true marble but an almost unlimited amount of desirable material is available.

The Missisquoi-Lautz Corporation, Limited, H. W. Richardson, president, Kingston, Ont.; A. E. Stevens, secretary-treasurer, Phillipsburg, Que.

The property of the company consists of 317 acres; 160 acres in the parish of St. Armand west, and 157 acres in the village of Phillipsburg, Missisquoi county. The formation is regarded as of Lower Chazy or perhaps Beekmantown age. Locally the rock consists of a series of limestones more of less metamorphosed into marble. The beds strike north and south and dip eastward at an angle of about 20°. While much of the stone might be considered marble the more desirable portion is found in a belt about 1,000 feet wide near the eastern side of the property.

The quarry is at present about 400 feet long and 100 feet wide; it has been sunk through the following beds:—

5 ft.—Grey stone only occasionally used.
5 ft.—Grey stone only occasionally used.
4 ft. 6 in.—Grey stone only occasionally used.

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[1] Geol. Sur. Can., Rep. 1895, p. 153 J

[2] Geol. Sur. Can., Rep. 1863, pp. 273-287, 844-862.
Ibid, Rep. 1887-88. pp. 39-40 K.
Ibid, Rep. 1894, pp. 16 J, 30-32 J. 89 J.

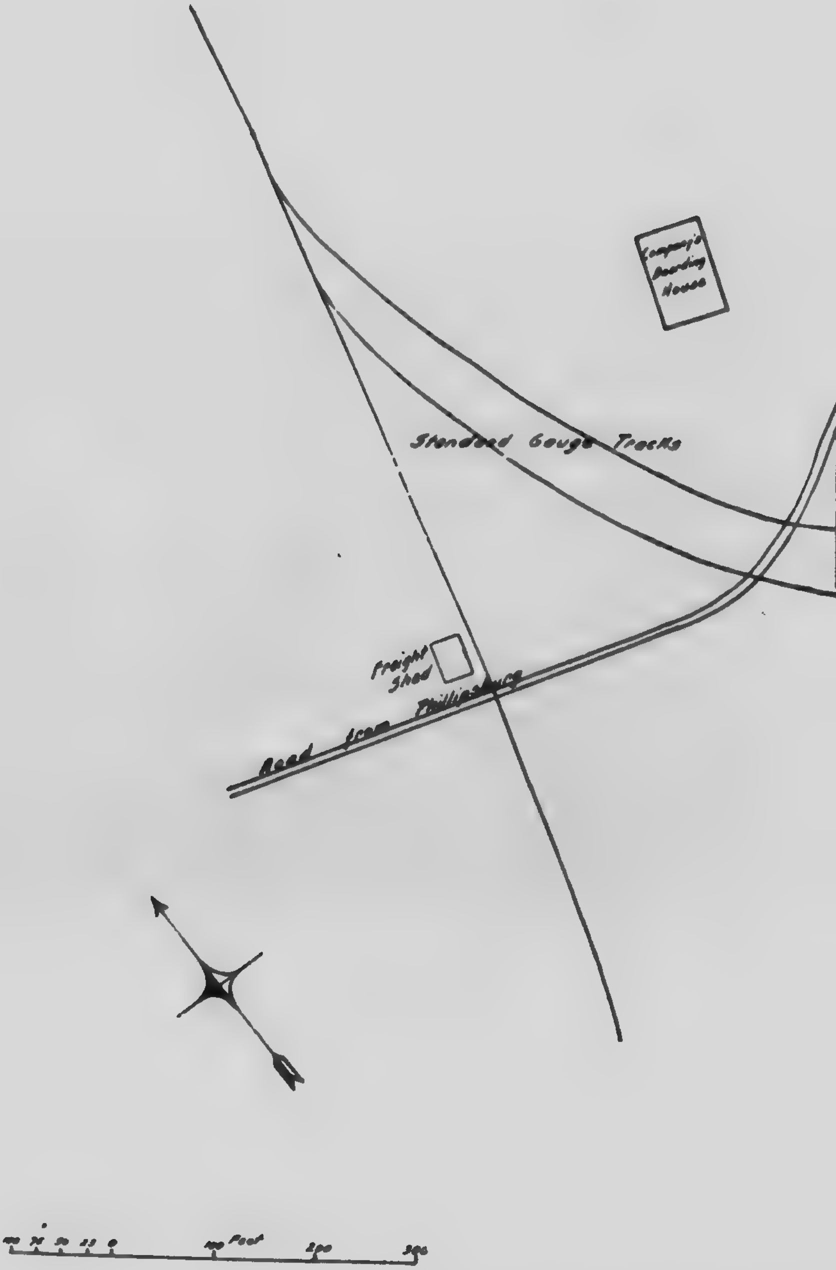
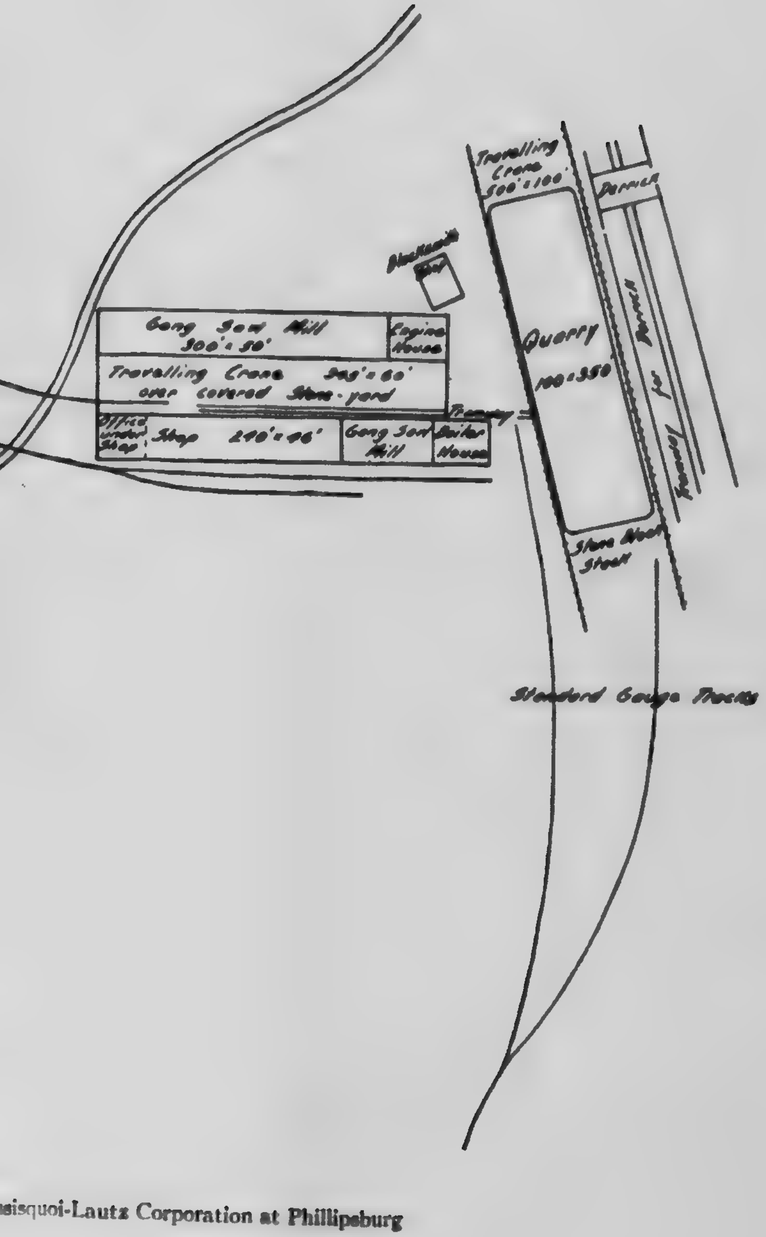
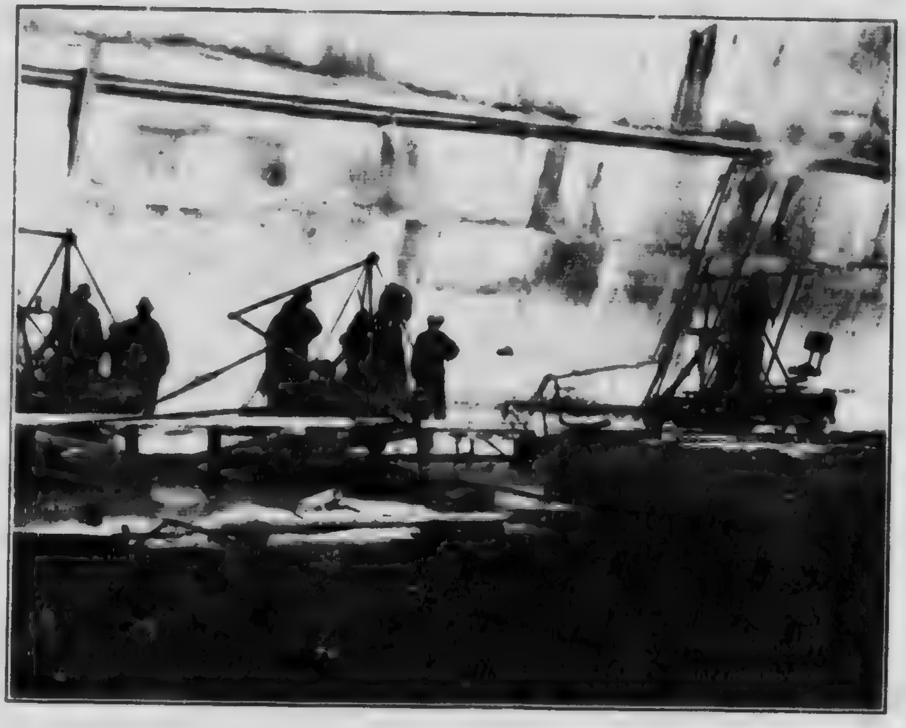


Fig. 10—Plan of the property of the Missisquoi-La



sisquoi-Lautz Corporation at Phillipsburg



Missisquoi marble. Channelling machines in the quarry of the Missisquoi-Lautz Corporation, Phillipsburg, Que.

11 ft. 6 in. Solid bed of mottled stone (711
3 ft.—Vert gris (712). in one bed
1 ft.—Dark grey (713).
3 ft. 6 in. Light grey (714)

3 ft. 6 in. Green veined stone; cut parallel to the bedding it is known as "regina" (715 a) and vertical to the bedding as "rex" (715 b). The lower six inches which is of a darker green colour is called "emeraldo" (716)

3 ft. 6 in.—Sovereign grey.
1 ft. Seagreen (718).
9 in.—Vert rose (719
[illegible]. Hard bed, not used.
3 ft. 6 in. Bolder grey.
5 ft. Silver grey.
1 ft. Regale (722) in one bed
2 ft.—Dark grey.
3 ft. 6 in. Mottled dove.

Core drills show that grey and greenish varieties continue to a depth [illegible] 150 feet or more.

The chief joints run with the strike (a little east of north) parallel to the long diameter of the quarry. These fractures have caused the rejection of considerable material, but as the quarry increases in depth, they are found to become much less frequent.

The stone: No. 711.—This variety known as "Mottled" consists of a light greyish fine grained base spotted with [illegible] coarser crystallization. The white portion occurs in rounded dots of half inch or more in diameter and also in the form of irregular bands [illegible] an inch in diameter extending for several inches. The white [illegible] uniform opaque white but shows darker spots owing to the presence of [illegible] calcite crystals. Fine lines of a yellowish colour are seen in places between the white and the grey components.

No. 712.—Vert gris is a very handsome marble with a greyish base similar to that of No. 711 but rather lighter and somewhat clouded in darker and lighter shades of grey. The rock is traversed throughout by fine irregular greenish lines arranged in a net-like manner with irregular meshes from one quarter inch to an inch or more in diameter. Where these films of colouring matter are cut across, the green line is darker and more sharply defined but where the face of the slab follows the plane of a veinlet the colour is a very light shade of yellowish green. The stone might be described as blotched with yellowish green and lined irregularly with darker green (Plate XLI).

No. 713.—Dark grey Missisquoi consists of a medium light grey base, spotted with small and more or less angular dots of a lighter colour. Scattered through this matrix are larger angular spots of a much darker grey. This general grey complex is banded in places with a variety closely resembling Vert gris described above as No. 712.

As this stone is employed for outside work as well as for decorative purposes it was tested in full. The portion used was free from intermixture with the Vert gris and shows on the broken surface an exceeding fine grained matrix with scattered crystals of a larger size. The corrosion test renders the surface white and dull and accentuates the more crystalline spots.

The physical properties are given below:

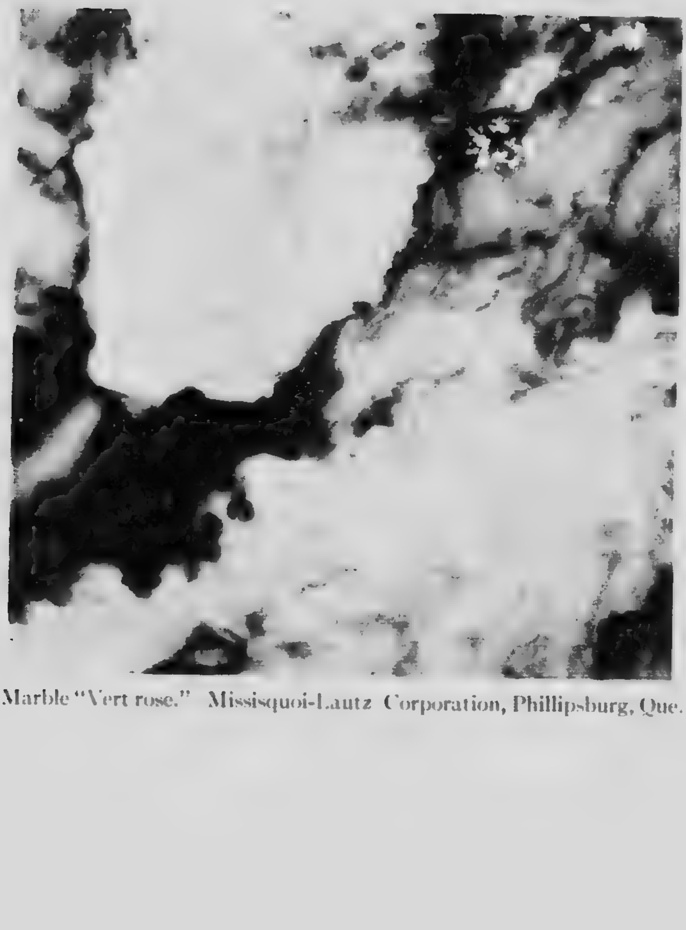
Specific gravity	2.716
Weight per cubic foot, lbs.	169.273
Pore space, per cent	0.163
Ratio of absorption, per cent, one hour	0.0281
" " " two hours	0.0322
" " " slow immersion	0.0602
" " " in vacuo	0.0602
" " " under pressure	0.0602
Coefficient of saturation, one hour	.46
" " " two hours	.53
" " " slow immersion	1.00
" " " in vacuo	1.00
Crushing strength, lbs. per sq. in., dry	20,380.
" " " " wet	19,560.
" " " " wet after freezing	18,250.
Transverse strength, lbs. per sq. in	2,256.
Shearing strength, lbs. per sq. in	1,135.
Loss on corrosion, grams per sq. in	0.03472
Drilling factor, mm	11.4
Chiselling factor, grams	5.4

No. 714.--Light grey Missisquoi marble resembles the variety described as "Mottled" but the grey matrix is lighter and the spots are smaller and farther apart. The arrangement of the lighter portions in bands as sometimes occurs in "Mottled" is not observed here. The fractured surface shows a very fine grain and scarcely any of the glistening crystals which are observed in the dark grey variety. In places however the broken surface shows films of the greenish colouring material observed in Vert gris. The etched surface is dull and white with the spots darker and of a slightly greenish cast.

The physical properties are as follows:-

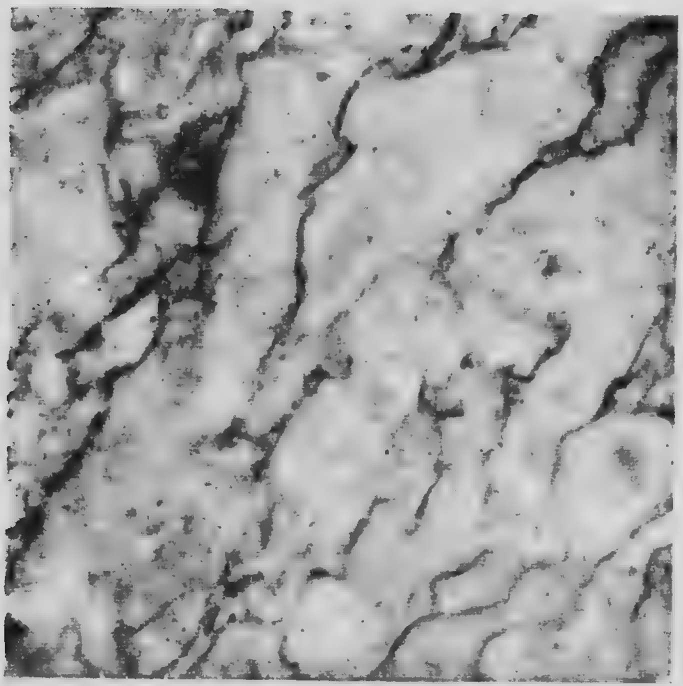
Specific gravity	2.714
Weight per cubic foot, lbs.	169.161
Pore space, per cent	0.155

Plate XL.



Marble "Vert rose." Missisquoi-Lautz Corporation, Phillipsburg, Que.

Plate XLI.



Marble "Vert gris." Missisquoi-Lautz Corporation, Phillipsburg, Que

Ratio of absorption per cent, one hour	0.0419
" " " " " two hours	0.0476
" " " " " slow immersion	0.0573
" " " " " in vacuo	0.0573
" " " " " under pressure	0.0573
Coefficient of saturation, one hour	.73
" " " two hours	.83
" " " slow immersion	1.00
" " " in vacuo	1.00
Crushing strength, lbs. per sq. in., dry	20,360
" " " " " " wet	16,350.(?)
" " " " " " wet after freezing	16,560
Transverse strength, lbs. per sq. in.	1,987
Shearing strength, lbs. per sq. in.	1,205
Loss on corrosion, grams per sq. in.	0.03071
Drilling factor, mm.	10.6
Chiselling factor, grams	5.6

No. 715 a.—Regina is of the same general type as "Vert gris" already described. The base however is much lighter—almost white—and the green veins are not arranged in a net-like manner but occur in irregular clouds with more of the light yellowish green showing. This is to be expected as the stone is cut roughly parallel to the thin green streaks which are here arranged in a parallel manner and not in a reticulation as in "Vert gris." A considerable amount of pyrite in small grains was observed in this stone.

No. 715 b.—Rex is the same stone as "Regina" but it is cut at right angles to the green layers which therefore appear on the surface of the slab as irregular but roughly parallel lines of varying shades of green.

No. 716.—Emeraldo resembles "Regina" but the green portion is much darker and more abundant: fully half of the surface shows some shade of green varying from yellowish to deep sea green. Pyrite is rather abundant in this stone.

No. 718.—Sea green Missisquoi marble consists of a very fine grained white base delicately clouded with yellowish green. Throughout this matrix a darker green occurs in clouds and contorted lines.

No. 719.—Vert rose is one of the most highly coloured of the Missisquoi marbles: it consists of a base resembling "Emeraldo" but darker and with a larger proportion of green. Scattered through this base are wide clouds, in places two inches in diameter, of a mottled white and rose coloured type which takes a most brilliant polish. No pyrite was observed in this example (Plate XL).

No. 722. Regale resembles "Sea green" but the matrix is scarcely as clean and contains occasional pinkish spots.

The present practice in quarrying is to run channel cuts about 4 or 5 feet apart across the quarry, i.e., in the direction of the dip: this divides the floor into a series of strips 100 feet long. A single cut is then made along the eastern wall. Parallel to this last cut, a second one is made whereby a series of blocks is cut off from the eastern or lower end of the long strips resulting from the first set of channels. Owing to the presence of a distinct parting between the beds, no difficulty is experienced in "raising" these end blocks. The remaining 90 or more feet of each strip is broken into blocks by shims and wedges, advantage being taken of joints when they occur. This method is found to be more satisfactory than the running of a second series of channels at right angles to the first set because it is much less expensive and it removes the danger of having a flaw through the middle of a block.

The quarry is sunk deeper at the southern end and the various beds are left exposed as a series of steps. This method makes any bed accessible in case a large order is received for that particular variety. Good flat floors are presented as successive layers are removed: these floors slant about 20° to the east in accord with the dip of the beds (Plate XXXIX).

The quarrying plant consists of the following appliances:

5 No. 6½ Sullivan swivel head channellers operated on steam from central plant. Actual efficiency about 60 sq. ft. in a day of 10 hours.

2 "Z" Sullivan channellers, operated by direct steam.

1 "VX" Sullivan channeller (Climber), operated by direct steam.

2 "D19" Sullivan hammer drills, operated on air.

2 "U.C." Sullivan bar drills, steam.

2 Ingersol drills, steam.

1 Smart-Turner pump, 2½ in. discharge.

1 Electric crane, Dominion Bridge Co. The span is 100 feet, i.e., the width of the quarry. The runways are supported on steel columns with concrete foundations which are placed 10 feet apart. The total length [illegible] 500 feet. The crane therefore commands any part of the quarry and extends 100 feet beyond at the south end. The speed is 187 feet per minute light, and 60 feet loaded. The main hoist has a capacity of 30 tons; there is also a supplementary hoist with a capacity of 5 tons.

1 travelling derrick, capacity 20 tons, with boiler and hoist.

The blocks from the quarry may be loaded directly on cars for shipment or on trucks which pass by gravity to the mill.

The mill building consists essentially of three sections—a central part or gang yard, 345 feet long by 60 feet wide by 60 feet high, and two outer parts each 50 feet wide. The section on the north side of the yard is 40 feet high and is divided into two parts, a gang saw mill 88 feet long and a boiler room 85 feet long; this last section projects beyond the gang yard.

In considering the equipment of the various sections of the mill it is advisable to begin with those devoted to the development of power.

The boiler room is equipped with two Jenckes 100 h.p. boilers, one Jenckes 150 h.p. boiler, one Erie [illegible] h.p. boiler and one McDougall 160 h.p. boiler. All the boilers are arranged in a battery and are equipped with Foster superheaters which raise the temperature of the steam to 525° F.

and is said to increase the boiler efficiency 25 per cent. Each boiler is equipped with the forced draught system of the Cotton Furnace Co., Newark, N.J. The fan is operated by a 16 h.p. motor and is driven at a speed of 350 revolutions per minute. A feed water heater is used and a Babcock and Wilcox purifying tank.

The boilers supply steam to the engine room and also to the drills and channellers in the quarry. A mixture of soft coal and anthracite slack is used; about 450 tons a month are consumed in the summer when the quarry is in operation and 300 tons per month in the winter.

The engine room is provided with two Belliss and Morcom high speed engines. The larger engine develops 430 h.p. and drives a long line shaft, which extends nearly the full length of the mill. Within the engine room the shaft is connected by belt with a 200 K.W. dynamo by the Lancashire Dynamo and Motor Co., Manchester. This dynamo is driven at 460 revolutions per minute and develops 220 230 volts. A supplementary pump for water supply is driven from the line shaft at 1040 revolutions per minute. The second engine develops 175 h.p. and is directly connected to a 120 K.W. Allis-Chalmers-Bullock dynamo developing 240-250 volts with a maximum amperage of 480. This current is used as an auxiliary for lighting and for pumping water when the larger engine is not running.

The gang yard. The gang plant consist of 18 single pitman saws by the Patch Manufacturing Co. The average speed of operating is 98 strokes a minute with a swing of about 18 inches. The saws are of various sizes and are capable of receiving blocks up to 14 feet in length and 7 feet high. The effective cutting power varies from one to three inches per hour. Sand and water are supplied to the saws by 8 Frenier sand pumps. The travelling crane which commands the whole of the gang yard has a 56 feet span with run-ways 365 feet long. The capacity is 30 tons. The gang yard also accommodates a diamond saw by the Geo. Anderson Company, Montreal. This machine has an efficiency of 4 to 5 inches per minute on average stock 3 feet thick. Two men are required for its operation and a 10 h.p. motor is used for reversing. A Sturveysant roller jaw crusher with a capacity of three carloads a week is used for converting waste material into crushed marble for terrazo flooring. Twelve of the saws and the rest of the machinery mentioned above are operated from the long line shaft.

The mill. The more important machines in the mill are as follows: -One carborundum machine by the Patch Manufacturing Co. The efficiency is 6 inches per minute for ordinary mouldings. With steel centered wheels, slabs $\frac{7}{8}$ in. thick can be cut at the rate of 9 to 11 inches per minute. The machine is driven at the rate of 1,500 revolutions per minute.

Four rubbing beds by the Patch Manufacturing Co. The plates are 5 inches thick. Three of the beds are 12 feet in diameter and one is 14 feet.

One planer by the Patch Co.

Three polishing machines of the ordinary type. The heads consist

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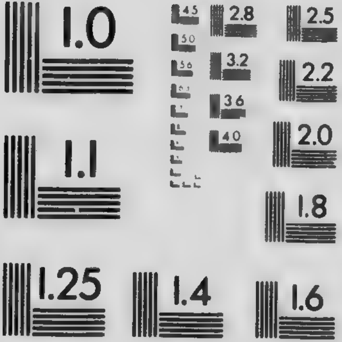
(ANSI and ISO TEST CHART No. 2)



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(716) 288-5989 - Fax

successively of two grades of composition grit, one hone and a polishing buffer of compressed felt used with putty powder and oxalic acid to give the final gloss.

One torpedo machine by Emil Offenbacher, Markt-Redwitz, Bavaria. This apparatus is said to have a cutting capacity of 18 inches per minute on one inch slabs.

One compressor supplying air at 80 lbs. per sq. in. to 10 pneumatic tools and two drills.

One emery wheel.

The diamond saw and the crushing machine are operated from the line shaft. The rest of the machinery is supplied with power from the large dynamo which also serves the quarry crane, a triplex pump for pumping water from the lake, a spare compressor using 22 h.p. and delivering 100 cubic feet per minute, six of the gang saws, and street, house and mill lighting.

The general equipment of the company includes 43 buildings and a water system of 3,700 feet of piping with a six inch intake in the lake. This system is operated by a Blake triplex power pump. Six miles of railway equipped with one locomotive, one passenger car and one flat car is operated by the Phillipsburg Railway and Quarry Co.

The company has recently installed a Doherty-Eldred forced draught kiln from which it is producing from 85 to 90 tons per week of a lime said to be 98 per cent pure. Recent development work consists in the driving of a tunnel 58 feet long and 27 feet deep and in the stripping of an area north of the present quarry with the view of extending the workings in that direction. The company has also taken over the mill at Bridgeburg, Ont., which was constructed by the Lautz Company of Buffalo. This mill is capable of turning out between $300,000 and $400,000 worth of finished work per year.

Two hundred men are employed in the quarry and works at Phillipsburg. Missisquoi marble may be seen in the following buildings:—

University of Saskatchewan, Saskatoon.
Parliament buildings, Toronto,
Post-office, Toronto,
Canadian Northern hotel, Winnipeg,
Château Laurier, Ottawa,
Grand Trunk Railway station, Ottawa,
Transportation building, Montreal,
Windsor hotel, Montreal,
Bank of Toronto, Bloor and Dufferin branch, Toronto.
Gillette building, Montreal,
Metropolitan building, Vancouver,
Post-office, Vancouver,
Bank of Commerce, Vancouver,
Bank of Ottawa, Vancouver,

King George hotel, Saskatoon,
Public library, Regina,
Bank of Nova Scotia, Winnipeg,
Portage building, Winnipeg,
Canadian Niagara Power building, Niagara Falls,
British Columbia Electrical Company's building, Vancouver,
Asylum buildings, Brandon,
Parliament buildings, Edmonton,
Custom house, Quebec,
Windsor station, Montreal,
Royal Ontario museum, Toronto.

The following prices are selected from the company's published list.

Sawn stock, full size of block, unfinished, uncrated, f.o.b. cars, Phillipsburg.

	Per sq. ft.				Per cubic ft.
	⅞ in.	1¼ in.	1½ in.	2 in.	
Light grey Dark grey Mottled grey Vert gris	$ 45	55	65	.90	4.00
Rex Regina Emeraldo Sea green Regal	$.80	.90	1 00	1.10	8 00
Vert rose	$1.50	2.00	2 60	3.20	15 00

Finished work, jointed to size, crated, polished one face, ⅞ in. thick, not over 6 ft, long or 4 ft. wide, per sq. ft.

Light grey Dark grey Mottled grey Vert gris	$1.20	Emeraldo Sea green	$2.00	Rex Regina	$1.50
		Vert rose	$2.50		

DUDSWELL AREA.

The marbles of the township of Dudswell have been regarded as of economic importance since the region was first examined by officers of the Geological Survey of Canada. Sir William Logan refers to them in the following words: "The light grey limestones which are of a rather more durable character, sometimes exhibit 300 feet of vertical thickness in a single exposure. The colour of the rock, from light grey, becomes in some layers of a uniform yellowish white or cream colour. The beds of this colour seem to be more compact than other portions of the rock, and some of them will probably yield excellent marble. Both these beds and others near them, of a mottled dark and light grey, are penetrated by a multitude of reticulating veins of yellow dolomite. On the surface of cut slabs, portions of the grey limestone occasionally approach to black. If any of these beds should be found to give a more uniform or a darker grey or a black they would yield a marble approaching in character to the celebrated Portor, or black and gold marble. In this also the black ground is a pure limestone, while the yellow reticulating veins are of dolomite."[1]

Dr. Ells refers to the marble as follows: "A large deposit of crystalline limestone, forming a marble of very excellent quality is found in the township of Dudswell, at Lime Ridge and vicinity. Within the last two years, attention has again been directed to this locality, and a company has been formed in Sherbrooke to thoroughly test the value of the property. The marble is of several colours, takes a beautiful polish and presents a very handsome appearance, especially a kind known locally as "black and gold" the yellow being due to the presence of veins of dolomite. There are also several shades of grey. In places the ledge is composed almost entirely of fossil corals, the polished slabs of which present a very peculiar and pretty mottled aspect."[2]

The attempt to work this deposit has not met with the success anticipated and the property has been abandoned for many years. See page 221.

Dominion Lime Co., Montreal; James Barker, superintendent, Lime Ridge, Que.

The large quarry of this company at Lime Ridge is operated for the making of lime only but as the stone is of marble grade, a brief description will not be out of place.

The formation strikes E. 10° N. with a steep dip to the northward. The main joints run N. 20° E. and dip 70° to the westward. Many inclined and irregular fractures occur, but in places, blocks of considerable size could be obtained. The quarry is about 300 feet by 350 feet and 175 feet deep. The lower part of the opening, especially on the west side, shows a most distinctive division into horizontal sheets which at first sight might be mistaken for beds. Six of these layers, 10 or more feet thick, are very sharply defined.

The stone varies from an unattractive grey and slaty colour to a fine grained greyish crystalline variety (757).

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[1] Geol. Sur. Can., Rep. 1863, p. 432. See also *ibid*, pp. 617, 827.

[2] Geol. Sur. Can., Rep. 1886, p. 68 J. See also *ibid*, Rep. 1885, p. 51 A; *ibid* Rep. 1886, p. 36 A., p. 11 A; *ibid* Rep. 1888-89, p. 127 K.

te stone: No. 757. - A fine grained bluish-grey crystalline limestone irregularly interbanded with a lighter type of a less transparent appearance. This stone is of marble grade but it does not possess any particular beauty of colouring.

The product is used principally for lime of which about 900 tons a month are shipped. The smaller fragments, unsuitable for lime burning, are crushed for macadam and concrete work. There is no production of building stone.

Forty men, on the average, are employed in the quarry and a number more in miscellaneous work.

The marble quarry referred to by Ells is situated on lot 22, range VII, Dudswell, and now belongs to the present company. The formation strikes E. 10° N. and dips 70° or 80° to the northward. Vertical joints striking north and south cut the formation at intervals but they are not so closely spaced as to interfere with the extraction of blocks of commercial size.

The old quarry is about 40 feet square and has been sunk to a depth of only a few feet by means of old fashioned channelling machines, one of which is still on the property.

Several acres of stone are accessible near the opening but the amount of desirable material is much more limited. The formation consists mainly of a highly fossiliferous greyish blue limestone which shows different degrees of marmorization: in places it is scarcely altered (753) while in others it is converted into a fine grained white marble. These two varieties as well as many intermediate types are interbanded, sometimes to such an extent as to make the stone excessively laminated. This banded effect is increased, particularly in weathered examples, by the presence of a yellowish dolomitic material which is interlaminated with the marble. The excessive lamination and the tendency of this yellowish material to decay detract greatly from the value of much of the stone. Besides being arranged in parallel bands the grey and the white components are sometimes so irregularly mixed as to produce a mottled rock (754). This mottled type shows various degrees of crystallization; a highly crystalline variety is described below as No. 756. Many of the fossils which were originally imbedded in the limestone still remain so that the polished surfaces show the cross section of these fossils and produce a unique effect. In places also the stone is cut by numerous secondary stringers of white calcite.

It will be seen from the above remarks that a considerable quantity of the general run of the quarry is undesirable on account of insufficient crystallization and a dull unattractive colour and that much of the better material is injured by excessive lamination. Some very satisfactory marble can doubtless be obtained but it would be difficult to quarry uniform material on a commercial basis.

The stone: No. 753. A dark grey very fine grained stone of semi-crystalline structure. It is cut in all directions by veinlets of white calcite of coarser texture.

No. 754. An extremely fine grained white crystalline limestone in which the white is mottled with grey to such an extent that the grey surpasses the white in amount: it resembles Plate LI, No. 14, and also shows the dark dolomitic bands in places.

No. 755.—A dark grey fine grained crystalline limestone with fossil corals in abundance. On polished surfaces the whiter fossils against the grey ground produce a very handsome effect.

No. 756.—Resembles No. 754 but is more thoroughly crystalline: this marble is shown in Plate LI, No. 14. The yellow (gold) veins are scarcely apparent in the plate but in some specimens they are more abundant.

The blocks now lying in the quarry show different degrees of alteration from the action of the weather. The grey stone is most affected while the more crystalline varieties have proved more resistant. The yellowish dolomitic bands, while they may enhance the beauty of fresh surfaces, do not contribute to the durability of the stone as this portion of the complex was found to be the most seriously altered.

No stone has been raised from the quarry for 25 years and I have been unable to learn that any was ever shipped. The haul to Lime Ridge is a little more than a mile and should the proposed Quebec Eastern railway be built it will pass close to the old quarry.

ST. JOSEPH AREA.

The occurrence of bands of crystalline limestone in the Sillery slates of Beauce is referred to by Ells in the Report of the Geological Survey for 1887-88. He states that they are to be ascribed to the Sillery formation and that they sometimes reach a width of 40 feet with occasional exposures for a distance of half a mile.[1]

Rupert Simpson, Simcoe, Ont.

On the east side of the Chaudière river close to the southeast boundary of the seigniory of St. Joseph lie some narrow limestone bands which have attracted attention as a possible source of decorative stone. In the year 1900 Mr. T. Morrison examined the outcrops with a view to working them and later, in 191˟ the property was acquired by Mr. Simpson.

Outcrops of crystalline limestone may be traced for a distance of about 1200 feet in a direction N. 50° E. lying between the reddish Sillery slates which constitute the country rock. There is no proof that the limestone is a continuous band but it appears rather to occur in the form of lenticular masses with a width of about 20 feet. The layers dip with the country rock about 80 to the southeast. In places the limestone is accompanied by a dark rock in a decomposed condition which appears to be of volcanic origin.

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[1] Geol. Sur. Can., Rep. 1887-88, pp. 113-114 K.

All the outcrops are badly shattered and there is no means of ascertaining to what extent this shattering is due to surface agencies. Rock from the north end is described as No. 917, that from the middle as No. 918, and that from the south as No. 919

The stone: No. 917.—This is a rather hard, fine grained, red marble, veined and blotched with white calcite of coarser grain. It closely resembles Plate LII, No. 11 but the black element observable in the figure is absent and the grain is a little coarser giving a more shimmering effect to the surface. The stone would make very handsome decorative material if it could be procured in quantity.

No. 918.—Resembles No. 917. The red portion is slightly duller and more of a brick-red colour. The grain is a little finer.

No. 919. Similar stone but it is interbanded with a hard red fine-grained rock of a siliceous slaty nature which would render difficult the extraction of blocks suitable for sawing The colour is a little lighter and the grain similar to No. 917 from the north end of the exposures.

PORT DANIEL AREA.

"The two conspicuous points on the east side of Port Daniel bay, of which the northern one is called the Devil's cape, exhibit the upper limestone (Silurian) in a nearly vertical attitude, with its encrinal character well marked........The Port Daniel limestone is of an excellent description for burning, and is well fitted for mortar or for agricultural purposes. Very beautiful flag and tile stone might be obtained from some calcareo-arenaceous strata, which occur a little westward of the brook, in Anse à la Vielle, and split readily into large and very even plates of almost any required thickness from a quarter of an inch to three or four inches, from the presence of a small quantity of mica in the divisional planes."[1]

The picturesque cliffs referred to by Sir Wm. Logan are composed in part at least of semi-marmorized limestone of Silurian age. This stone was formerly quarried for lime burning and was shipped to Prince Edward Island by McLean and Leitch of Charlottetown, and later by McDonald Brothers. There has been no production since 1905. East of the wharf at Port Daniel the strata have a general southwest strike with a high but variable dip to the southeast. The westerly and consequently the lowest layer consists of about 50 feet of reddish marmorized limestone with numerous fossils. This is followed by 100 feet of less altered argillaceous bands

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[1] Geol. Sur. Can., Rep. 1863, pp. 445-446. See also *ibid*, Rep. 1880-82, p. 14 D; *ibid*, Rep. 1883, p. 27 E.

(817) beyond which the reddish limestone again occurs. For some miles eastward the reddish limestone continues with the same strike and dip (819).

The whole formation is much mixed, the limestone alternating with bands of red and grey shale and rough limestone conglomerates (Plate XLII).

A tunnel on the A. Q. and W. railway passes through the cliff and shows throughout its length of 100 yards the marmorized rocks alternating with reddish uncrystallized bands (814).

The better portion of the limestone bands would make handsome decorative material but the alternating character of the beds and the shattered condition of the formation would entail a large amount of waste in quarrying. There is no doubt however that fairly large blocks could be obtained in places.

The stone: No. 819.—This stone which is of the most importance from the present point of view consists of a light reddish base of very fine grain through which are scattered veins and patches of a white and more coarsely crystalline calcite. In different places the relative abundance of the two components and the coarseness of the intermixture varies greatly. In places the white veins are two or three inches in diameter and in others they are mere threads. Plate LII, No. 12 shows an average piece of this stone. The red portion is difficult to polish owing to its soft and argillaceous nature. On this account the stone would probably not prove very durable if exposed to the weather.

No. 817.—A fine grained bluish grey rock apparently formed of minute calcite crystals in an argillaceous matrix. It is of no possible value as a decorative stone.

No. 814.—This variety is much more massive and homogeneous than No. 619. It presents a mottled pink and white surface in which the pink parts are the crystalline remains of fossils. The stone is of rather coarse grain but it is susceptible of a high polish and is a durable and handsome material.

Other Occurrences of Marble in the Palæozoic Strata.

Besides the occurrences already referred to the literature contains a few references to other localities of which the chief are as follows:—

Beauce county.

Geo. Sur., Can., Rep. 1887-88, p. 85 K. *Limited outcrops of greyish sub-crystalline limestone of Cambrian age used for lime near Beauce Junction, in the township of Mialloux, and near West Broughton.*

Richmond county.

Geol. Sur. Can., Rep. 1886, p. 13 J. *Considerable outcrops of crystalline limestone like that at Dudswell on lot 11, range XII, Stoke, and on lots 14 and 15, range IX, Dudswell.*

PLATE XLII.

Silurian marble. Cliffs at Port Daniel, Que.

Stanstead county.

Geol. Sur. Can., Rep. 1894, p. 41 J. *Crystalline limestone at Magoons point, Lake Memphremagog.* (See below).

Drummond county.

Geol. Sur. Can., Rep. 1894, part J. *General geology of Kingsey township.*

Of the above localities, the occurrences in Kingsey and at Magoons point were considered the most important and are described below.

Henry Armstrong, owner, Trenholm, Que.; J. McMorine, owner of quarrying rights, Richmond, Que.

In association with the slates at the old Kingsey slate quarry on lots 4 and 5, range I, Kingsey, Drummond county, there occurs a belt of metamorphosed limestone of a prevailing red colour. The band strikes northeast with the slates and has a probable width of 100 feet, but the exposures are few and isolated. The red marble is cut by numerous veins of white calcite and is a very handsome material. Unfortunately, quartz veinlets also occur in abundance; none of the exposures are free from them and in consequence it is doubtful if any workable material could be quarried.

The stone: No. 769.—This stone is a fine grained dark red marble traversed by veinlets of white calcite. In places the red portion shows a brecciated structure with small fragments of a bright jaspery red in a somewhat darker base. The general appearance of the stone is very like that of the red marble from Orford mountain shown in Plate LII, No. 11.

G. F. Greenwood, Montreal.

At Magoons point in the township of Stanstead, county of Stanstead, a fine grained, bluish laminated marble was formerly quarried for lime burning. The belt of marble lies between greyish schists and has been opened for a distance of 300 feet along the strike. The excavation is about 30 feet deep and varies in width from 50 to 200 feet. Except where opened, the belt is not observable as the country is heavily covered with drift; further, the presence of water in the quarry makes it impossible to obtain data as to the solidity [illegible] otherwise of the formation. There has been no production for many years.

The stone: No. 7[illegible].—This is a fine grained bluish white glistening marble with a prom[illegible]led structure. The stone has a strong tendency to split pa[illegible] this banding. Iron-bearing solutions have soaked in along the p[illegible] banding and have stained the stone bright red. Pieces sawn across [illegible] bands are very pretty, showing a pure bluish white alternating with bright red bands. This effect is evidently due to surface agencies and cannot be relied on to occur throughout the mass of the deposit.

CHAPTER VIII

SERPENTINES AND SERPENTINE MARBLES OF THE PROVINCE OF QUEBEC.

Serpentine is a mineral which results from the alteration of basic magnesian minerals such as olivine, augite, and hornblende. It [illegible] of secondary origin and never occurs as an original constituent of the igneous rocks. The more basic igneous rocks such as the peridotites which are composed entirely of basic magnesian minerals, are subject to an alteration *en masse* into serpentine, resulting in a rock of inferior hardness compared with the original but frequently possessing a semi-translucency and colouring which render it highly desirable as a decorative stone. The most common colour is green, but other tints are frequently presented of which yellow is probably the most important.

Serpentine is often interbanded with calcite; the two minerals may be irregularly intermingled or the calcite may occur in the form of stringers and veinlets traversing the serpentine. The mixed rock is known as ophiocalcite or verd-antique; it is also referred to as serpentine marble.

The Province of Quebec contains numerous and large deposits of serpentine, both the massive variety and verde-antique. The occurrences may be ascribed to three general regions—the Eastern Townships, Gaspé, and the district north of the Ottawa river particularly the county of Argenteuil. In a general way it may be said that the serpentines of Gaspé and the Eastern Townships are of a dark green to brown colour with little calcite, while the serpentines of the northern district are of a brighter green colour and more intermingled with calcite.

The references to the occurrence of serpentine in these several regions are numerous and are often accompanied by statements as to their economic possibilities as producers of ornamental stone.

Despite the many promising reports the fact remains that there is no present production of this stone nor has any attempt at quarrying gone beyond the prospecting stage. It would appear that the failure to successfully quarry serpentine and serpentine marble in the Province of Quebec may be traced to the following causes: -

1st. The serpentines of the Eastern Townships are very badly shattered, so much so, that I have observed no place where a block 6 feet long could be obtained. Further, an examination of the rock at depth, as exposed in the great pits of the asbestos region, shows no diminution of the cracks and joints encountered near the surface. It is of course impossible to say that this condition maintains throughout the region and too few of the occurrences have been examined personally to justify a sweeping statement in this respect, nevertheless I am strongly of the opinion that excessive fracturing will always prove a strong deterrent factor in the working of these deposits.

2nd. The very dark green, almost brown colour of the majority of the serpentines of the Eastern Townships is rather too sombre for architectural or decorative purposes.

3rd. The deposits of the Ottawa river district seem to be too limited in extent and too variable across the strike to permit the extraction of blocks sufficiently uniform for the making of slabs which will match up in a piece of work.

In spite of the discouraging factors mentioned above it is to be remembered that very little serious prospecting has been done and that no deposit has actually been examined at depth. In view of the many occurrences over wide areas it is a reasonable assumption that workable deposits will yet be found.

Numerous references to the occurrences of serpentine are to be found in the reports of the Geological Survey of Canada. Many of these references are made with respect to the asbestos industry and many others are unaccompanied by any note as to the fitness of the material for decorative purposes. The serpentine belts from which asbestos is mined are described for the Eastern Townships in the Report of the Geological Survey for 1886, pp. 41–44 J, and for the Ottawa area in the Report for 1899, page 105 J.

A full account of the asbestos-bearing serpentine areas is given in the Monograph on Chrysotile-asbestos, Publication No. 69 of the Mines Branch. A more condensed account may be found in Guide book No. 2 of the Twelfth International Geological Congress.

The following list contains only those references in which the suitability of the material to decorative purposes is pointed out. It will be observed that with a few scattered exceptions, the promising areas lie in the townships of Grenville, Melbourne, and Orford.

Argenteuil.

Geol. Sur. Can., Rep. 1863, p. 824—*Pale green with spots and clouds of a rich red brown, lot 13, range V, Grenville.*

Ibid. p. 823—*Slabs obtained on lot 16, range III, Grenville, also in the Augmentation of Grenville and on Calumet island.*

Geol. Sur. Can., Rep. 1899, p. 137 J.—*A beautiful stone but too much shattered for decorative purposes on lot 17, range VII, Grenville.*

Geol. Sur. Can., Rep. 1888–89, p. 128 K.—*General remarks.*

Ibid, p. 127 K.—*Occurs with marble at Grenville, St. Andre Avelin and the Augmentation of Grenville.*

Beauce.

Geol. Sur. Can., Rep. 1865, p. 825.—*Green brecciated serpentine with white veins near St. Joseph on the Chaudière.*

Ibid. Rep. 1888–89, p. 18 K.—*The above associated with iron ore.*

Berthier.

Geol. Sur. Can., Rep. 1892–93.—*Serpentine limestone apparently of little promise on the side of a high hill in De Maisonneuve.*

Gaspé.

Geol. Sur. Can., Rep. 1863, p. 825.—*Serpentine of Mount Albert in Gaspé.*

Ibid. Rep. 1886, p. 62 J.—*Serpentine at Ste. Anne des Monts and on Dartmouth river.*

Ibid. Rep. 1890–91, p. 20 S.—*Serpentine in Shickshock mountains.*

Montmagny.

Geol. Sur. Can., Rep. 1866-69, p. 137.—*Masses in Talon township on lots 10-13, range VI.*

Ottawa.

Geol. Sur. Can., Rep. 1888-89, p. 128 K.—*Serpentine marble quarried at Templeton by the Canada Granite Co.*

Ibid. Rep. 1899, p. 60 O.—*The variety known as Eozoon canadense at Côte St. Pierre in the Seigniory of La Petite Nation.*

Pontiac.

Geol. Sur. Can., Rep. 1863, p. 471.—*Serpentine on Calumet island.*

Ibid. Rep. 1894, p. 62 A.—*Serpentine on Calumet island.*

Richmond.

Geo. Sur. Can., Rep. 1863, p. 824.—*A serpentine belt for four miles on the fifth and sixth ranges of Melbourne. Dark blackish-green serpentine with angular spots of a lighter colour.*

Lot 20, range V, Melbourne shows a serpentine of lighter colour and a dark green variety veined with red. Also occurs on lot 27, range V, Melbourne.

G. S. C., Cat. Sec. I, Mus. p. 118.—*Lot 21, range VI, Melbourne; lot 22, range VI, Melbourne; lot 20, range X, Melbourne; lot 20, range V, Melbourne.*

Sherbrooke.

Geol. Sur. Can., Rep. 1863, p. 825.—*Dark green serpentine in a lighter paste of magnesian carbonate of lime on lot 12, range XVIII, Orford.*

Ibid. Cat. Sec. I, Museum, p. 118.—*Lot 6, range XIII, Orford; lot 12, range VIII, Orford; lot 15, range XVIII, Orford; lot 6, range XIII, Orford; lot 5, range B, Orford; lot 7, range A, Orford; lot 8, range III, Shipton; lot 7, range VIII, Orford.*

Wolfe.

Geol. Sur. Can., Cat., Sec. 1, Museum, p. 119, 1893.—*Light and dark green serpentine in South Ham.*

As already stated, the three important regions for decorative serpentine are in Melbourne, Orford, and Grenville. The occurrences in these three townships are numerous but it may be said that each township represents a separate type. The important serpentine areas will therefore be considered under the three areas as above.

MELBOURNE AREA.

Serpentine is said to occur on lot 20, range V, Melbourne. This lot is now included in the village of Kingsbury and I was unable to learn of any attempt having been made to quarry the stone. The range of hills lying northwest of the slate quarries is mainly composed of a light coloured eruptive rock. In this rock bands of serpentine are developed more particularly as the slate belt is approached. As far as a cursory examination shows the serpentine bands are narrow and mixed with the common rock, the whole formation being much fractured. It is quite possible however that places may be found in this range of hills capable of yielding material like No. 927, which was obtained on the road close to the slate quarries.

The stone: No. 927.—This stone is a massive and very dark green serpentine dotted with grains of chromite. Near the joint planes the stone is much lighter and more transparent. This example as typical of the great masses of dark green serpentines of the Eastern Townships is shown in Plate LII, No. 14. Near the bottom of the figure the lighter portion near a joint plane may be seen.

No. 771.—The serpentine mass northwest of the slate belt in the township of Cleveland is similar to that in Melbourne. The very dark serpentine is interbanded with a lighter olive-green type which in many places shows narrow bands of asbestos.

No. 772.—This example represents the darkest variety of the serpentines and shows the dark cores of the original basic minerals. Stone of this type has a value as decorative material where a very dark effect is desired. The specimen was obtained from the serpentine belt northwest of the old Steele slate quarry in the township of Cleveland. (Plate LII, No. 13).

Melbourne Slate Co., Philadelphia; J. W. Coulston.

North of the old Melbourne quarry on lot 22, range VI of Melbourne, a small hill of semi-decomposed basic rock contains bands of greenish serpentine in places dotted and streaked with chromite. Although no regular quarrying was ever attempted, museum specimens have been obtained from this outcrop. The surface is much shattered and presents no possibility of successful quarrying but it does not follow that the formation would prove the same throughout. As the Orford Mountain branch of the Canadian Pacific railway now runs close to the property, it would not be difficult to make a serious investigation of the outcrop.

The stone: 926.—When polished this material shows a dark brownish green serpentine with a brecciated structure in places. White and light green blotches are scattered throughout and the whole is intersected by fine white veinlets. The stone is undoubtedly a handsome decorative substance but it lacks the bright green tone that is in demand.

ORFORD MOUNTAIN AREA.

Fletcher Pulp and Lumber Co., Sherbrooke, Que.; East half, Lot 6 and southeast quarter of Lot 5, Range XII, Orford.

North of Webster lake in Orford, a serpentine range rises to a height of several hundred feet above the water. At different places in this range, small operations have been carried on for asbestos and for chromic iron ore. Incidentally some handsome varieties of serpentine have been revealed. In every instance however the formation appears to be too much shattered to make easy the extraction of blocks of commercial size. As surface work only has been done, it is of course possible that at greater depth more solid material might be encountered.

The first opening is not far from the lake at an elevation of 100 feet. The fracturing is excessive and, as far as the present hole is concerned, would make the obtaining of blocks impossible. Three varieties of stone are seen but it is questionable if any of them occur in sufficient amount to afford marketable pieces of unmixed material.

The types seen here are a massive green variety (777), a blue and green stone associated with chromite (778), and a white and green type (779).

A second opening on the opposite side of the same ridge shows a rather more solid formation with the joints striking N. 20° E. The rock is mostly of the massive green type or of a mottled light and dark green variety (780).

A quarter of a mile farther inland an opening has been made to examine an asbestos lead. The serpentine is of the ordinary dark type here, but a small amount of a red spotted variety also occurs (781).

Very dark serpentine is seen at the fourth opening which is at a greater elevation and about a mile inland. The formation is a little less fractured and consists chiefly of dark green serpentine with some blue and green varieties near the chromite which occurs in considerable quantity at this point (782).

The stone: No. 777.—A massive dark olive-green serpentine minutely clouded with the very dark variety and speckled with grains of chromite.

No. 778.—An olive-green serpentine with blotches of a lighter green which seem to represent imperfectly serpentinized crystals of the original rock. Darker coloured stringers accompanied by grains of chromite traverse the rock. The polished surface shows a mottled effect in three shades of green with minute veinlets of a darker colour. Numerous slickensided joint planes cut the formation and on these the colour is a bluish green. This is one of the most beautiful of the serpentines of the Eastern Townships and is shown in Plate XLIII.

No. 779.—Very light greenish serpentine mingled with large altered crystals of the original rock which present a still lighter shade of green. The whole is cut by numerous stringers of white calcite, associated with white glistening mica.

No. 780.—This is a very handsome example showing very bright light green serpentine mottled with a darker variety: it resembles No. 778.

No. 781.—Massive serpentine of a clear dark green colour veined with a lighter green type: it is shown in Plate LII, No. 15.

On the whole it may be said that some very attractive examples of serpentines occur on this location. The lighter green colours seem to be more abundant than in the Melbourne belt and the very dark massive type such as occurs in the asbestos region is much less in evidence. It is a reasonable assumption that a close examination of these ranges of hills would reveal many points at which material of a highly desirable character could be obtained. The fractured condition of the formation is likely to prove a more serious drawback than a lack of beautiful varieties of serpentine. The Orford Mountain railway has made many points easily accessible, and if the proposed Richmond, Stanstead and Magog railway is built, it will pass close to the properties described above.

GRENVILLE AREA.

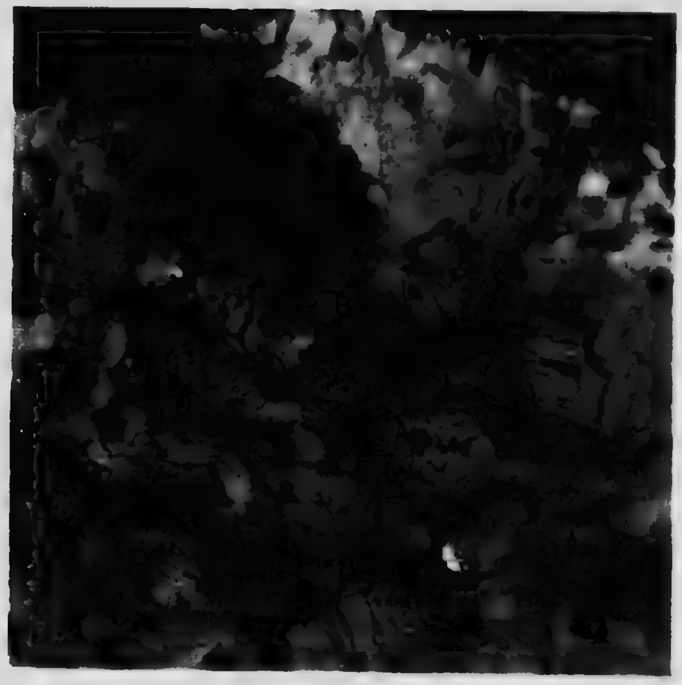
J. K. Ward, Montreal. Formerly the Calumet Graphite Mining and Milling Company.

Attempts to work the serpentine band on lot 16, range III of Grenville were made 60 years ago and at a more recent date by this company. The headquarters of the firm were at Scranton, Pa., and a car load of the product which had been extracted by means of a small channelling machine was shipped to that city.

The outcrop occurs at the head of the falls on Calumet creek and is of very limited extent as the surrounding country is heavily covered with drift.

The general trend of the formation is a little south of east and is traceable only for about 200 feet. On the south side of the exposure is a hard white and purplish quartzite followed by 10 feet of crystalline limestone. A dyke 4 feet wide of a fine grained eruptive occurs north of the limestone beyond which for 20 feet and an unknown distance farther is crystalline limestone with serpentine. This stone is disposed in beds of about 4 feet in thickness and appears to be much fractured throughout. Three types of stone may be recognized in these beds but the different kinds are not distinct but intermixed one with another—crystalline limestone spotted with serpentine (623), fine grained granular marble (624), and common coarse white crystalline limestone. In places the serpentine forms masses a foot or more in diameter of a dark olive-green colour. Brecciated structure is to be observed as well as numerous veinlets and flaws. The whole deposit seems much too variable for the extraction of blocks sufficiently alike to recommend the use of the stone for slabs in decorative work. Small pieces of the green stone could be obtained for the making of objects of limited size, and the spotted variety could be quarried in larger pieces.

Plate XLIII.



Serpentine from Orford mountain, Quebec.

The stone: No. 622.—Massive translucent olive-green serpentine showing glistening facets in places and occasional included crystals of white calcite; it occurs in association with No. 623.

No. 623.—This is the most abundant variety and gives the most promise of profitable extraction. The stone consists of a fine grained white crystalline limestone spotted throughout with small rounded pieces of light green serpentine: it is shown in Plate LII, No. 16.

No. 624.—A medium grained, friable crystalline limestone with occasional small dots of serpentine: it is a less valuable phase of No. 623.

Summary—Serpentine Marbles.

There is no actual production of this type of stone in the province of Quebec nor has any very serious attempt been made to determine the value of any of the deposits. The localities of occurrence are numerous and have been tabulated on page 228. The three most promising areas are in Grenville, Melbourne, and Orford.

The Grenville serpentine is light green and occurs with white crystalline limestone. In some cases the two components are roughly interbanded and in others the serpentine occurs as spots in the limestone (Plate 52, No. 16).

The Melbourne serpentine occurs in considerable masses in the vicinity of the state quarries of New Rockland, Melbourne, and Cleveland. The stone is of a dark brownish green colour and is frequently brecciated with a lighter green which however is still of a rather dark shade.

The Orford mountain serpentine is the most promising, as in places very beautiful stone with clouds of varying shades of green is presented (Plate XLIII).

The great serpentine ranges of the asbestos field do not give much promise as producers of decorative stone as the serpentine is of a very dark colour and without the beautiful markings of the stone from Orford mountain.

In all the deposits an excessive amount of fracturing was observed: this is the most serious obstacle to be met in the exploitation of the deposits on a commercial scale.

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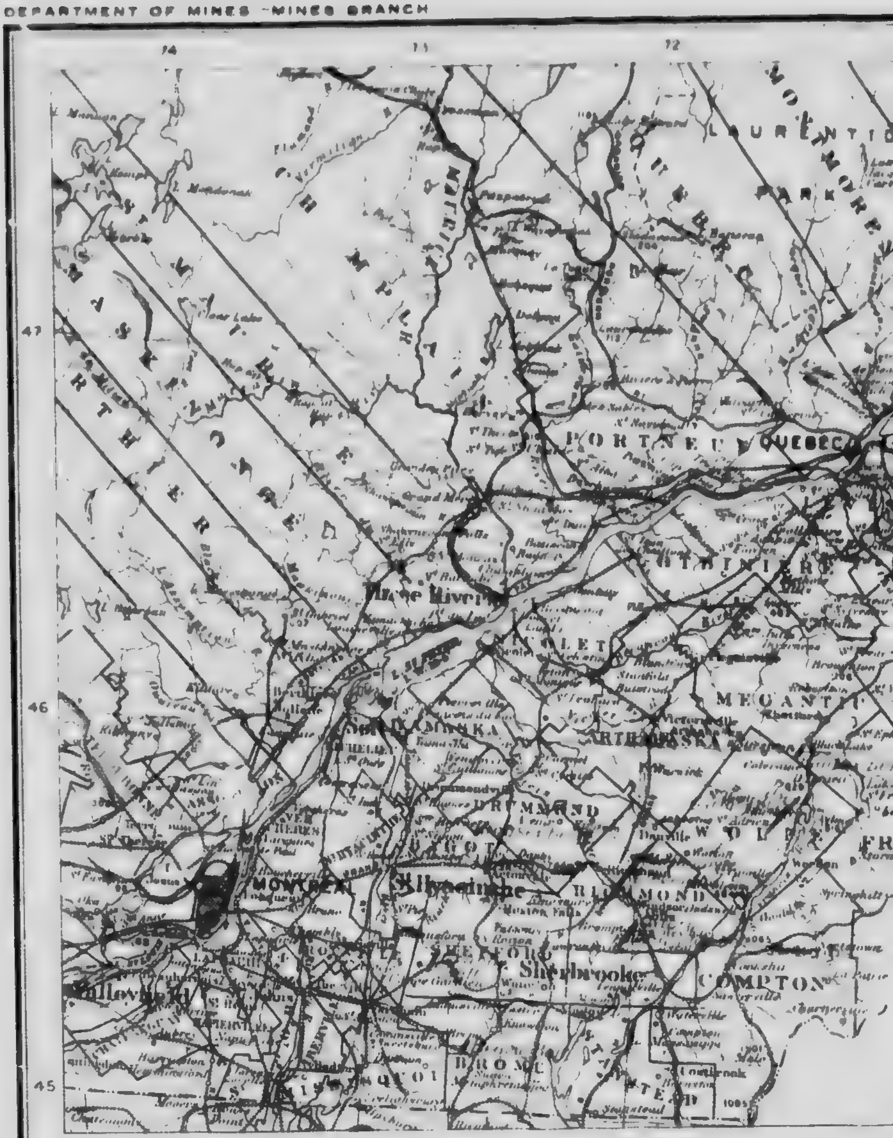
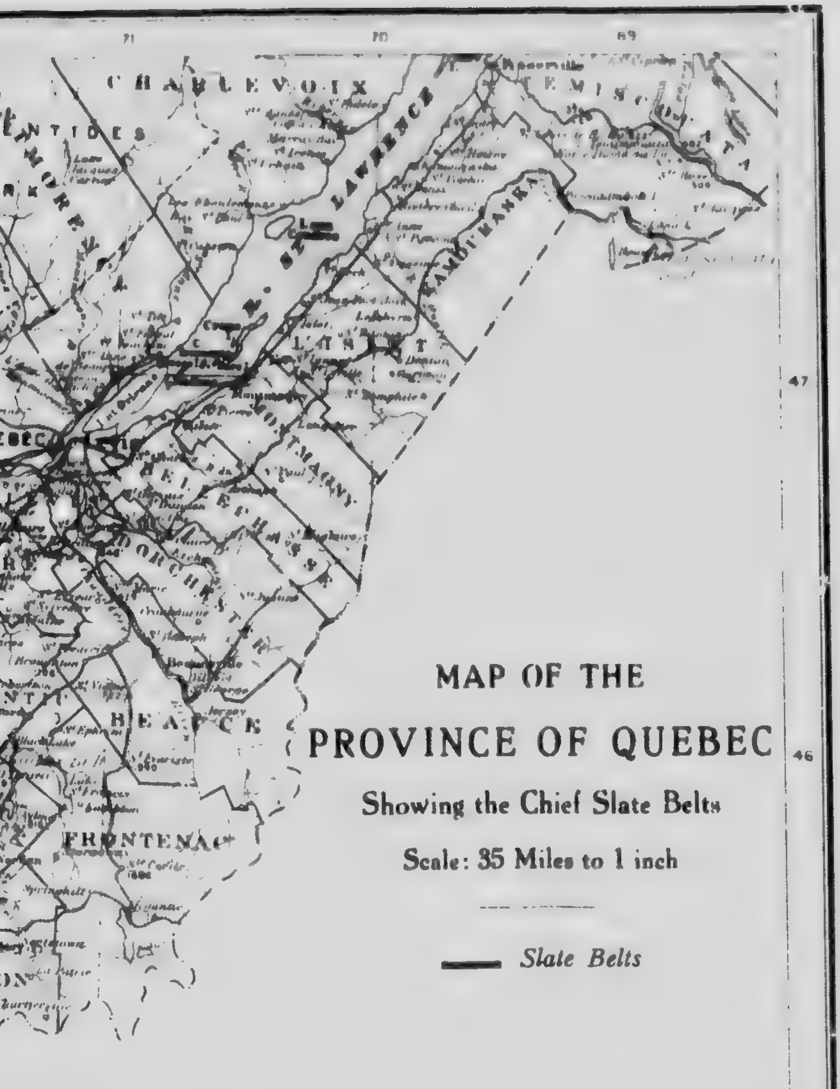
DEPARTMENT OF MINES—MINES BRANCH



BASE MAP. FROM PLATES OF DEPT OF INTERIOR



MAP OF THE

PROVINCE OF QUEBEC

Showing the Chief Slate Belts

Scale: 35 Miles to 1 inch

FIG. 11

CHAPTER IX.

ROOFING SLATE OF THE PROVINCE OF QUEBEC.

The fissile argillites of the Eastern Townships of Quebec have long been known as a source of slates suitable for roofing. These slates have been ascribed to different geological formations but it is probable that they belong, in the most part, to the Cambrian system which occupies a great part of the northeast and southwest troughs between the ridges of Pre-Cambrian rocks. While extensive areas of slate occur in the region it is not to be inferred that the workable deposits are at all comparable in extent with the geographical distribution of the slate formation. A considerable part of the known tracts consists of slates either too friable and fissile or too hard to be of possible value as producers of roofing slate. Extensive areas also are so cut by stringers of quartz or are so excessively jointed that the production of stock on a commercial scale is impossible. As slate is very susceptible to the destructive action of the weather, the determination of the value of a prospect from an examination of the surface is attended with many difficulties; in fact little more than a general idea of the character of the formation can be gained. The cleave of the slate, the nature of the jointing, and the amount of worthless material which is always considerable can be determined only at depth. In consequence it may reasonably be expected that further development may reveal numerous workable bands in the extensive tracts of the Eastern Townships.

The old Steele quarry in the township of Cleveland, Richmond county, was opened in 1854 and probably represented the first serious attempt to quarry slate in the province. Shortly after, several other quarries were opened on the same belt as well as others in different parts of the district. Great success does not seem to have attended the industry for only one of the old quarries has survived—the New Rockland slate quarry in the township of Melbourne. Recently however a new quarry has been opened near the line of the National Transcontinental Railway at Long Lake in Temiscouata county.

The chief belts of slate on which quarrying has been attempted are as follows:

(a) Melbourne-Cleveland area.
(b) Danville area which is probably a continuation of the above.
(c) Kingsey area.
(d) Acton area.
(e) Garthby area.
(f) Granby area.
(g) Orford-Brompton area.
(h) Temiscouata area.

After these better known belts have been considered, a list of references will be given to other localities of less importance.

Melbourne-Cleveland Slate Area.[1]

This slate belt lies on the southeast side of a narrow serpentine mass which represents the southwest extension of the great serpentine mass in which the asbestos quarries about Danville are situated. The slate is all of the dark type represented in Plate LI, No. 7. From the southwest to the northeast the following quarries have been worked:—

Prince Albert quarry, Williamson and Crombie, lot 24, range V, Melbourne.
New Rockland quarry, lot 23, range IV, Melbourne.
Melbourne or Walton quarry, lot 22, range VI, Melbourne.
Steele or Bedard quarry, lot 5, range XV, Cleveland.
......lot 6, range IX, Cleveland.

Prince Albert Slate Quarry, Williamson and Crombie, New Rockland, Que.

This quarry lies about two miles to the southwest of the New Rockland quarry and is probably situated on the same belt. The material is similar to that at New Rockland but very little work was ever done.

New Rockland Slate Co., H. B. Drummond, president; T. P. Bacon, secretary, Montreal, Que.; S. H. Frazer and E. O. Davis, managers, New Rockland, Que.

The company holds about 900 acres of land in the township of Melbourne, Richmond county. The quarry is situated in lot 23, range IV, Melbourne, at an elevation of 500 feet above the St. Francis river. The formation strikes N. 60° E. and dips 70°-80° to the southeast. As in the case of most of the slate belts of the Eastern Townships the formation as a whole is cut up and rendered useless by numerous stringers of quartz. The areas of workable material occur as bands between the more quartzose zones. In the present quarry, the good slate forms a belt about 200 feet wide bounded on the northwest side by a quartzose band and on the southeast side by a harder and more fractured slate which is succeeded by green serpentine. Several pits have been opened on the good belt but some of the older ones have been entirely filled with the debris from later operations.

The quarry was opened in 1868; the pit now being worked extends along the strike for 500 feet. The northwest wall is formed by a belt six

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[1] Geol. Sur. Can., Rep. 1863, p. 252; p. 830
Ibid., Rep. 1863-66, p. 44.
Ibid., Rep. 1888-89, p. 49 A; p. 128 K.
Ibid., Rep. 1894, p. 90 J.

PLATE XLIV.

Melbourne slate. New Rockland slate quarry, New Rockland, Que.

feet in width of hard slate with many quartz veins. This is followed by 60 feet of good slate, after which is 10 feet of worthless material succeeded by 70 to 80 feet more of good slate to the southeast wall. Here a narrow quartz seam striking N. 80° E. and dipping 80° to the northward forms a large part of the present wall. Parting planes occur parallel to both the strike and the dip of the formation at intervals varying from a few inches up to six feet: these are known locally as "slants." The major set of joints (back joints) strikes N. 30° W. and therefore crosses the formation at right angles. These partings occur at intervals up to 10 feet. A second set strikes with the formation and dips at angles varying from 0 to 45° to the northwest: these are known as the "foot joints" and occur at intervals varying from a few inches up to 6 feet. In addition to these more or less regular partings, there is, in places, a development of sharply inclined but limited diagonal cleavage planes known as "knives."

In the bands of good slate which are free from quartz veins there is little imperfection from foreign matter except for the occasional presence of thin calcite veins. There are few crystals of pyrite but a little of that mineral occurs in the so-called worms which are very generally distributed through the formation. Owing to jointing and to the fact that the upper 30 feet has to be rejected on account of weathering it is probable that little more than 10 per cent of the rock raised is marketable stock (Plates XLIV and XLV).

The stone: No. 762.—A dark grey uniformly colored mica slate with good cleavage and clear ring. The stock splits easily on the grain which is vertical. From the scallop, or direction at right angles to the grain, the cleave is less easily effected. The surface of the slates is fairly smooth and flat. Small papillose elevations occur in places caused by grains of hard siliceous matter. Considerable pyrite is present in small grains, but some slates seem to be quite free from these. The slate darkens on long exposure but the corrosion test gave no appreciable result. This slate is shown in Plate LI, No. 7.

The physical properties are: -

Specific gravity	2.752
Weight per cubic foot, lbs	170.97
Pore space, per cent	0.481
Ratio of absorption, per cent, one hour	0.0125
" " " " " two hours	0.0223
" " " " " slow immersion	0.105
" " " " " in vacuo	0.1273
" " " " " under pressure	0.178
Coefficient of saturation, one hour	.07
" " " two hours	.12
" " " slow immersion	.58
" " " in vacuo	.71

Crushing strength, lbs. per sq., in. dry	34,090.
" " " " " " wet	32,350.
" " " " " " wet after freezing	28,080.
Transverse strength, lbs. per sq. in	13,125.
Gain on corrosion, grams per sq. in	0.00195

The following analysis and tests of New Rockland slate are given by Ells.[1]

Analysis.

	per cent.
Silica	63.39
Alumina	15.97
Ferrous oxide	4.68
Manganous oxide	0.39
Lime	0.67
Magnesia	2.99
Potash	3.6
Soda	3.33
Loss by ignition	3.26
	100.26

Physical properties.

Specific gravity	2.75.
Crushing strength, strain perpendicular to lamination, lbs. per sq. in	26,574.
Crushing strength, strain perpendicular to lamination, lbs. per sq. in	32,069.
Crushing strength, strain parallel to the lamination but perpendicular to the grain, lbs per sq. in	36,531.

Transverse strength.

Strain perpendicular to lamination. A piece of slate 3 feet long, 4 inches wide and 1 in. thick, on bearers 30 inches apart, failed by splitting at 1,092 lbs.; modulus of rupture 11,667 lbs.

A duplicate failed at 950 lbs.; modulus of rupture 10,000 lbs.

A beam 12 in. long and 1 in. square failed at 558 lbs.

Deflection with pressure at 690 lbs. was 0.7 in.

No. 763.—This is the same slate as No. 762 but it is marred by the presence of "worms" which consist of lineal or curved inclusions sometimes several inches in length and about one-fourth of an inch thick. These inclusions consist of hard matter in which mica crystals may be seen.

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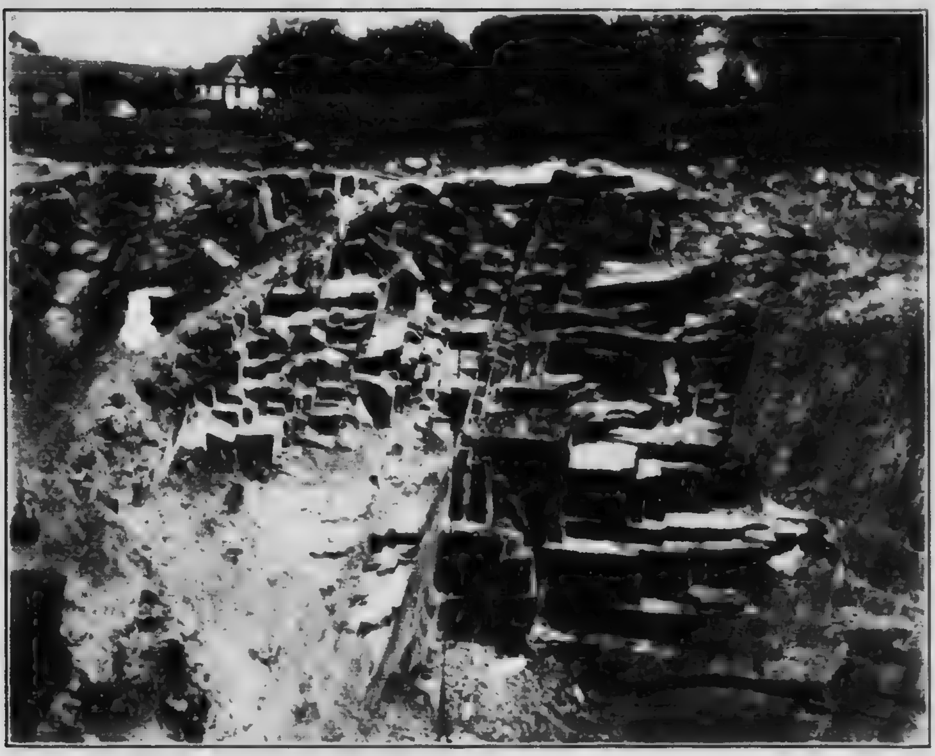
[1] Geol. Sur. Can, Rep. 1888-89, p. 130 K.

Plate XLV.



Melbourne slate. Jointing in New Rockland quarry.

Carbonate of lime is also present in places. The worms detract from the smoothness of the surface but they do not seriously interfere with the use of the slate for roofing purposes, except when accompanied by pyrite.

The large pit described above was abandoned at the close of 1912 and an exploratory cut was made in the hard belt to the southeast near the northern end of the quarry. Nothing promising was revealed by this cut which proved the width of the hard belt to be at least 70 feet. Surface examination however has shown that a second belt of workable material lies beyond this cut to the southeast. At this point it has a width of 15 feet but it seems to increase in width along the strike to the northeast. Acting on the information obtained from this exploratory work Messrs. Frazer and Davis are now engaged in opening a new pit on this belt at a point northeast of the big pit where there seems to be workable slate for a width of 175 feet. The surface material taken out is very promising and it is expected that stock capable of yielding good slate will be obtained at a depth of 30 feet.

Mr. Davis has kindly furnished the following account of the method of quarrying.

1st. A shaft is sunk to a depth of 40 or 50 feet in the useless material at the side of the "vein."

2nd. The shaft is extended into a channel across the formation and also along the edge of the deposit parallel to the strike.

3rd. The upper 30 feet is removed by explosives, thus exposing the good stock.

4th. From the side channel, that is, at right angles to the strike a horizontal hole is bored through to the first "slant." This hole is placed just above the first "foot joint": it is loaded almost full with powder, only an inch or two being left for tamping. The steel used in drilling these holes varies from $\frac{3}{4}$ inch to $1\frac{1}{4}$ inch according to the size of the block to be dislodged. The good stock is raised and carried by trams to the shanties. A shanty gang, in this quarry, consists of two men only, both of whom first work at blocking after which one man splits and the other trims. This arrangement is possible as the blocks do not require to be split immediately. Mr. Davis informs me that there is no perceptible loss of cleave by a delay of a week after making the blocks. In this connexion it is stated that frozen stock cleaves as well as the fresh material but that on thawing the stock can not be worked. Strange to say the cleave can be restored to some extent by again freezing. The shanty work is done by contract, the men receiving \$1 per square for small sizes and 90 cents per square for large sizes.

The equipment is roughly as follows:—

One Little Giant turbine developing 60 h.p.[1]
1,200 feet wire rope transmission in two sections.

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[1] Since my visit the turbine wheel house was destroyed by fire.

One boom derrick, operated by the above power, two derricks with cable ways and travelling carriage, operated by the above power, one 90 h.p. boiler supplying steam to 2 Rand drills, one steam hoist and the quarry pumps.

At the time of visit in 1912, 25 men were employed in the quarry and in general work, and 10 men in the shanties.

The production in 1911 was 1,833 squares valued at from $4.50 to $5.50 per square for No. 1 stock, f.o.b. Kingsbury. No. 2 stock is quoted at $4 to $4.25 per square according to size.

Seventeen sizes are made varying from 24 in. by 12 in. to 10 in. by 8 in. The medium sizes are considered the most valuable as below:

12 in. × 24 in. to 20 in. × 11 in.	$5.00	per square,	f.o.b.
20 in. × 11 in. to 16 in. × 8 in.	$5.50	"	"
14 in. × 7 in.	$5.00	"	"
12 in. × 6 in.	$4.50	"	"

The haul from the quarry to Kingsbury is about a mile. Most of the output is used in Toronto where it is handled by the Roofers Supply Co.

Williamson and Crombie, Kingsbury, Que.; Jenkins quarry, Lot 18, Range X, Brompton Gore.[1]

A small opening was made near Mud pond in Brompton Gore by Jenkins and Davis in 1891. The slate is of a purple colour but it does not seem to be durable so that the attempt was abandoned. It is possible that this location represents a continuation of the Melbourne-Cleveland belt.

The Melbourne Slate Co., J. Warren Coulston, Philadelphia, Pa.

This company holds the following properties in the township of Melbourne: lots 21, 22, 23, and 24, range VI, and lots 21 and 22, range VII, and part of lot 22, range V. The original quarry was opened in 1860 on a belt said to be one-third of a mile wide and was worked for a number of years. At a later date a second quarry was opened on a parallel vein southwest of the old workings but as the result was unsatisfactory operations were suspended after a period of activity of about 20 years in all.

The road to the old quarry is now choked with debris and the place is difficult of access. The formation strikes a little north of east with a varying but steep dip on both sides of the vertical, but chiefly to the southeast at about 80°. The old opening is 600 feet long, 200 feet wide and probably 100 feet deep. The foot joints are horizontal at wide intervals, but inclined partings dipping northeast at about 30° are much in evidence. The grain appears to be vertical as in the New Rockland quarries. Judging from the dump there must have been an enormous amount of waste.

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[1] Geol. Sur. Can., Rep. 1888-89, p. 131 K.

The stone: No. 924. This slate is very similar to that from New Rockland but specimens taken from the old dump are of no use for testing. A great amount of debris is present, much of which shows an undulating cleave. Iron staining is very conspicuous on many of the fragments. For a description of this quarry shortly after its opening see Report of Geol. Sur. Can., 1863, p. 830.

Danbrauseau, Richmond, Que. The Old Steele quarry, later J. C. Bedard; Lot 6, Range XV, Cleveland.

This quarry was opened in 1854 on the northeast side of a hill of which the bulk is serpentine. The opening is about 50 feet wide and of a slightly greater length along the strike. The height of the inner face is about 50 feet to the water which now fills the undrained part of the excavation.

The strike is N. 30° E. and the dip almost vertical. Owing to weathering, regular systems of joints are not easily made out. The most apparent set runs across the strike and dips to the northeast at about 60°. An indistinct set is approximately horizontal. On both sides of the excavation, the slates are hard, contorted and full of quartz stringers, and a similar band of about 10 feet in width occurs in the middle of the quarry. The northwest wall is badly iron stained and much of the excavated material shows a ribboned, uneven and crenulated structure. The refuse on the dump appears to be more fissile and decayed than in the other quarries on this belt. While some of the waste is of a dark colour, most of it has a silvery grey appearance not exhibited by the other quarries.

The stone: No. 770.—Much of the material on the old dumps is of silvery appearance and has become very fissile, other parts are darker and more like the New Rockland slate. A considerable proportion of the fragments are seriously cut by quartz veins: it is possible that operations were suspended owing to this cause. While it is impossible to judge of the quarry in its present condition it would appear that the prospects here are not equal to those of either the New Rockland or Melbourne quarries.

A selected specimen of the best stone was tested in part with the results given below:

Crushing strength, lbs. per sq. in., dry	30,580.
" " " " " " wet	10,000.[1]
Loss on corrosion, grams per sq. in.	0.000364

Griffith Estate, Granville, N.Y.

A belt of light green slate about 50 feet wide runs parallel to the New Rockland belt at about half a mile to the southeast. A small excavation about 10 feet deep was made but no marketable material was obtained. The slate holds its colour well but it is soft and liable to decay.

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[1] This test is useless as the wet cube slipped on the cleavage planes and broke out from one side.

Danville Slate Area.

Danville school slate quarry, Lot 7, Range IV, Shipton.

This old quarry, long since abandoned, was opened many years ago for the production of roofing slate, but at a later date, the product was used for the purpose indicated by the name. The excavation was made on the top of a minor elevation and is now about 400 feet long by 100 feet wide. The pit is full of water but a face of 15 feet is still visible (Plate XLVI).

The formation strikes N. 70° E. with a practically vertical dip. The foot joints are horizontal or with a slight dip to the westward. In parts of the quarry these joints are quite close together but in other places, they are separated by wide intervals.

A pronounced banding which probably represents the original bedding of the stone, strikes N. 20° W. with a dip of 50° to the southwest. The different bands present different colours which accounts for the diversity of colour seen in the waste material on the dump. Cross joints strike with the bedding but do not exactly correspond in dip. Quartz veins occur parallel to the formation and in some cases also appear on the foot joints. Five of these veins were observed in the length of the quarry.

As stated above slates of different colours occur but the prevailing tint is dark grey with a cast of purple which becomes more pronounced on weathering. Irregular columnar cleavage and the presence of considerable pyrite detract from the value of the quarry. Much of the material now obtainable still cleaves with facility and presents remarkably smooth and even grained parting faces.

It would appear from a short examination that an unlimited quantity of stone is procurable along the belt in this vicinity. There is no equipment and the quarry has been entirely abandoned for many years.

The stone: No. 773.—This stone is slightly lighter in colour than the New Rockland slate and has a very smooth cleave. It is doubtless very similar in its properties. The specimen is remarkably free from any irregularities, worms, or pyrite crystals. The following analyses, made to illustrate the varying composition of contiguous bands of rock, are taken from the Report of the Geological Survey, 1895, p. 60 J.

Two varieties of slate from the Danville quarry.

	No. 1	No. 2
Silica	55.75	67.85
Alumina	17.87	9.10
Ferrous oxide	9.05	11.14
Manganous oxide	0.70	0.79
Lime	1	0.98
Magnesia	5.81	3.23
Soda	1.12	1.80
Potash	2.97	0.44
Loss on ignition	5.26	4.55

Plate XLVI

Danville slate. The old Danville school slate quarry.

A quarry was opened in similar slate in 1854 on lot 9, range VI, Cleveland.[1]

Kingsey Slate Area.

Henry Armstrong, Trenholm, Que.; Lots 4 and 5, Range I, Kingsey.

A very large body of the slate doubtless occurs on this property: it is to be observed for more than a quarter of a mile along the St. Francis river in the direction of the strike, and it is encountered inland under a moderate covering of drift for an equal distance. The continuity of the belt for this distance across the strike is of course not proved.

The smooth glaciated surface of the formation is exposed in the cellar of Mr. Armstrong's house where the strike is N. 60° E. and the dip northwest at 60°. Joints or partings parallel to the formation occur at intervals of 2 to 10 inches. Joints across the formation strike N. 40° W. but only one of these was observed. On the whole, the outcrop at this point is very promising. The actual quarries were opened along the river bank which rises to a height of about 125 feet above the water: they were worked in an upper and a lower bench (Plate XLVII). No quartz veins or crystals of pyrite were observed throughout the exposures, but occasional green blotches occur. The formation strikes due northeast and dips 60° to the northwest or towards the river. Vertical joints run due southeast at wide intervals. The good slate is bordered by a hard quartzose band close to the river.

The tendency to split across the cleavage is very marked and is plainly shown by the exposed surface. These lines of parting do not run straight down the dip but incline at about 10° to the southeast. The somewhat irregular cleavage and the strong tendency to part at right angles detract from the possibilities of the deposit (765). A little farther down stream the formation is more shattered with a strong development of foot joints. The material on the dump has retained the colour well but the sheets have lost the "ring" and are much broken up.

The opening in the lower bench shows the same features as the upper, but foot joints dipping to the southeast at a low angle are more apparent.

It is unfortunate that the attempt to quarry this slate was made along the brow of the escarpment bordering the river for surface agencies have here had the most favourable opportunity to promote decay. There is little doubt that an opening some distance inland would have greater chances of success.

A smaller opening a short distance up stream shows a rather more solid formation with slate of a redder colour (766). Still farther up, a variety described below as No. 767 is presented. Just beyond, a green band of unknown extent is encountered (768).

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[1] Geol. Sur. Can., Rep. 1863-66, p. 44.

[2] Geol. Sur. Can., Rep. 1863, p. 830; p. 600.

Geol. Sur. Can., Rep. 1888-89, p. 128 K.

The stone: No. 765.—A deep purplish grey slate with good cleave but giving a surface which is slightly crenulated. The ring is not very clear but it is to be remembered that we are dealing with material that has been exposed for many years.

No. 766.—A dark red slate very similar in colour and in the condition of the surface to the Actonvale slate shown in plate LI, No. 8. The slates show light green blotches in places.

No. 767. A purplish slate darker than No. 766 but with less grey than in No. 765. The cleave is pronounced [illegible] of undulatory character.

No. 768. A light green slate. The surface material seems to be very fissile and friable but the formation would doubtless improve with depth.

An analysis of "a purplish blue slate", probably No. 765, is given in the Report of the Geological Survey, 1863, p. 600, as follows:

	per cent.
Silica	54.80
Alumina	23.15
Ferrous oxide	9.58
Lime	1.06
Magnesia	2.16
Potash	3.37
Soda	2.22
Volatile matter	3.90
	100.24

Acton Slate Area.

Eugene Morin, Actonvale, Que.

On this property, lot 26, range V, Acton, a quarry known as the Rankin Hill was opened in 1875. It is thus described by Ells. "The rock is said to be easily quarried and belongs to what is known as the Sillery portion of the Quebec group. It was opened in 1875 and was worked for two years when it was closed, owing it is said to a lack of market and the low price at that time of the output. This quarry had, in 1877, a length of 150 feet by 60 in breadth, and with a depth in one place of 35 feet, and in 1877 produced about 600 squares of slate."[1]

This old quarry was visited but little can be learned as it is overgrown with vegetation and partially filled with water. The formation strikes S. 20° W. and dips 30° southeasterly. Where visible the rock is

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[1] Geol. Sur. Can., Rep. 1888-89, p. 129 K.

Kingsey slate. Old quarry on St. Francis river, near Trenholm, Que.

excessively shattered but no conclusions can be drawn from its appearance. The dump shows much material of inferior cleave and numerous pieces heavily blotched with green. Some of the slate is very red and of uniform colour which seems to be permanent.

The stone: No. 830.—This red slate is shown in Plate LI, No. 8. The old material on the dump seems to be of poor cleave but it is scarcely fair to judge the quarry by the refuse. A series of tests was conducted on this stone as typical of the red slates of the Eastern Townships.

Specific gravity	2.801
Weight per cubic foot, lbs	173.045
Pore space, per cent	1.034
Ratio of absorption, per cent, one hour	0.141
" " " " " two hours	0.168
" " " " " slow immersion	0.2815
" " " " " in vacuo	0.345
" " " " " under pressure	0.373
Coefficient of saturation, one hour	.37
" " " two hours	.45
" " " slow immersion	.76
" " " in vacuo	.92
Crushing strength, lbs. per sq. in., dry	30,550.
Transverse strength, lbs. per sq. in.	4,245.
Shearing strength, lbs. per sq. in.	1,620
Loss on corrosion, grams per sq. in.	0.000364

The corrosion test resulted in a slight darkening of the colour.

It must be remembered that all of the above tests were made on material that had been exposed for thirty years or longer to the action of the weather.

Garthby Slate Area.[1]

West of Lake Aylmer in the township of Garthby, Wolfe county, a broad band of slate crosses the country, E. 30° N. No work has been done beyond picking out a little of the surface material at several points. It is a reasonable assumption that careful prospecting and the necessary amount of developing might reveal workable belts.

The slate on the south side of the road in lot 47, range I.S. is exposed over a wide area with a strike E. 30° N. and a vertical dip. The formation seems to be favourable and the slate is quite fissile but the surface material has a dull ring and it is much spotted with pyrite (922). In range I N., across the creek from this locality, the slate is exposed at a higher level and over a wide area. In places it is hard and unsuitable but in others it gives promise as far as can be judged from the surface of yielding workable stock at depth (923). All along the road to Garthby the slate is exposed at intervals, but it does not look so promising as the cleave is less defined and of an uneven and undulating nature (924).

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[1] Geol. Sur. Can., Rep. 1888-89, p. 128. Slates occur on lots 15, ranges VIII and IX, Garthby.

The stone: No. 922.—A greyish slate of the New Rockland type but with the lighter colour and smooth cleave of the Danville variety. The hand specimen although taken from the surface shows the stone to be perfectly fresh when broken. The cleave is irregular as might be expected in material taken from the surface, but where the break has followed the natural cleave the stone could scarcely be distinguished from the Danville slate. Much less pyrite is to be seen on the broken surface than would be expected from the quarry observations made above.

No. 923.—Resembles No. 922 but is not in as good condition, as the cleavage planes show brown iron staining.

No. 924.—A similar slate but slightly lighter in colour. The cleave is remarkably smooth but somewhat undulatory. The specimen is from the surface and shows brown iron staining on the cleavage planes into which water has soaked. Cleavage planes which have not been thus affected are very smooth and clean.

Granby Slate Area.[1]

Moise Robert, Granby, Que.

Red slate was quarried on the line between lots 15 in ranges VIII and IX of Granby. The old opening is so overgrown with vegetation and shattered by surface agencies that nothing is to be learned as to the character of the jointing, etc. The belt of red slate appears to be about 300 feet wide and has been traced for a distance of 1,000 feet along the strike, N. 25°E. The beds dip towards the southeast at 50°. The material on the dump seems to show an excessive number of fine diagonal partings which doubtless was one cause for abandoning the quarry. I am of the opinion that the quarry was opened at an unsuitable place, as it is situated on the edge of a slight rise where weather action would be excessive. It is possible that better material could be found on some other part of the belt.

Joseph Aubin, Granby, Que.

Slate is exposed on lot 14, range IX, Granby, where a small quarry was operated. This slate belt lies parallel to and south of the red slate, from which it is separated by a hard quartzose rock. The slates strike N. 25°E. and dip 70° to the southeast. The quarry was opened in the form of a narrow trench diagonally across the strike; it is about 20 feet deep at the south end.

The stone: No. 933.—This slate is of a brilliant deep red colour much more intense than that shown in Plate LI, No. 8. The specimen was taken from the old dump and can scarcely be considered typical: it is deficient in cleave, of crumpled lamination and excessively cut by diagonal joints.

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[1] Geol. Sur. Can., Rep. 1894, p. 90 J.

The stone: No. 934. A light greenish, rather hard looking slate with irregular cleave; it resembles the green slate from the St. Francis river, No. 785, but it is less fissile and does not show the same smooth cleavage planes. Brown stains are conspicuous on the partings but it must be remembered that we are dealing with refuse material which has been exposed on the dump for years.

Orford-Brompton Slate Area.

This belt may be observed on the St. Francis river below Brompton falls where a little quarrying has been done for flags. From this point it extends southwest and has been quarried in at least two places, while prospects still farther southwest may prove the continuity of the belt to the vicinity of Webster lake.[1]

W. Berwick, Sherbrooke, Lot 2, Range V, Orford, Sherbrooke county.

A quarry was opened on the above lot by Aylmer and Atkinson nearly fifty years ago. Considerable work was done in the quarry and in road making, but as far as I can learn no great amount of material was ever shipped.

The quarry is situated on the north side of Key brook near where it crosses the Orford-Brompton line. The excavation is about 100 feet long and 40 feet wide. The formation strikes N. 40°E. and dips 72° to the southeast. Strong joints cross the formation N. 55°W. with a dip of 80° to the southwest: these are closely spaced in part but intervals of 2 feet are not uncommon. Many of these joints are not continuous and would probably disappear with greater depth. There is undoubtedly a large amount of good slate in this belt but critical remarks as to the extent of fracturing, etc., would be entirely unwarranted with respect to a slate quarry which had been exposed to the action of the weather for fifty years. Judging from the material on the old dump, the stone is very durable both in colour and in wearing properties.

Occasional crystals of pyrite occur but their presence is now revealed only by the cubical casts where the original crystals have weathered away.

The specimens described below were selected from an old pile of trimmed sheets half buried in the mud. The fact that these have remained intact speaks well for the durability of the material.

The stone: No. 760.—A grey mica slate of somewhat lighter colour than either the New Rockland or Danville types. The cleave is smooth like in the Danville slate. The fragments show little evidence of decay or of rusting by the decomposition of pyrite.

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[1] Geol. Sur. Can., Rep. 1863, p. 830.
Geol. Sur. Can. Rep. 1888-89, p. 128 K

Transverse strength, lbs. per sq. in. 4,060

This result is probably low as the material was old and broke by splitting along the cleave.

On Mr. Berwick's property but not on the same lot, another small quarry was opened on the same or a similar belt about quarter of a mile to the northwest of the main opening.

Valcourt, Bromptonville, Que.; Lot 29, Range V, Brompton.

The slate range which crosses the property is in all probability the same as that on the land of Mr. Berwick and of which a further continuation is seen on the railway north of Windsor Mills. Exposures are numerous both on this and on adjoining properties. As usual, much of the exposed slate is filled with quartz stringers but bands free from this objection are not uncommon. The actual opening is about 20 ft. by 20 ft. with a maximum depth of the same amount. The formation strikes N. 40°E. with a dip of 80° to the southeast.

Strong joints cross the formation N. 70°W.; these are about 2 feet apart and are smooth and clean. A second set (foot joints) strikes with the formation and dips at about 30° to the northwest. These divisional planes occur at intervals varying from a few inches up to 10 feet and occasionally more. It would appear that a good body of slate is available at this point. I understand that operations were stopped owing to differences between the operators and the owner of the land. The quarry is still referred to locally as the "Innes" although the property has passed into other hands.

The stone: No. 761.—This slate is similar in all respects to No. 760.

Transverse strength, lbs. per sq. in. . . . . 3,163.

This result is doubtless low as the material was old and yielded by splitting along the cleave.

Fletcher Pulp and Lumber Co., Sherbrooke, Que.

Slates occur on range VII of Orford on the property of the above company. A pit was sunk and a few samples taken but no further work has been done.

The stone: No. 785.—This is a light grey slate similar to Nos. 760 and 761. Little can be said with regard to its properties as the specimen is badly stained by surface agencies. The cleavage planes are not flat but show a ribbed effect due to differences in the original layers of clay from which the slate was formed. Colour differences are also to be observed corresponding with the ribs on the cleavage faces. The material seems less desirable than the product of many of these old test pits.

Temiscouata Slate Area.

Frazer and Davis, New Rockland, Que.; Quarry address, Long Lake, Que.

This firm controls the following properties in Temiscouata county near the line of the National Transcontinental railway: parts of lots 39, 40, and 41 in range VIII, and lots 39, 40, 41, and 42 in range IX of the township of Bottsford.

A very extensive slate formation crosses the country in a southwest direction. At the point where the quarry is now opened on the shore of Long lake the excellence of the slate exposed in the railway cutting attracted the attention of Mr. J. A. Dresser while examining the region for the Geological Survey. Mr. Frazer estimates that the belt of workable slate is 154 feet wide and that it extends far to the southwest: it is not found on the opposite side of the lake. Work was begun on May 15, 1910, and 150 squares were made that year from surface workings. The first openings were made below the line of the railway which is about 20 feet above the water. These lower openings have been abandoned and a new quarry is being worked into the hill above the track (Plate XLVIII).

The slate strikes N. 60° E. with an almost vertical dip. The major joints strike northwest and dip 45° northeast: fractures also occur with the same strike but with a dip of 80° to the southwest. Foot joints dip 20° to the northwest: these are irregular and sometimes 5 feet apart. The grain is not vertical as in the New Rockland quarries but is developed in a northeast direction at an angle of about 24° from the horizontal which is practically the same as the original bedding planes which are perceptible in places.

I am informed by Mr. Frazer that blocks of Temiscouata slate are more easily split from the scallop and the New Rockland slate from the end; also that the weakest way in the New Rockland slate is with the scallop and in the Temiscouata slate across it.

A derrick with a steam hoist, a steam pump and two Rand drills have been installed. Ten men are employed. About 200 squares have been made to date, September, 1913, but none will be shipped until the railway is in operation. Mr. Frazer proposes to market the product at the same rate as the New Rockland slate, i.e. at an average price of $5.25 per square, f.o.b. quarry.

The slate is very uniform in colour and is slightly darker than the New Rockland product. No worms, veinlets or iron staining were observed at the quarry (840).

The stone: No. 840.—This slate is of the dark colour shown in Plate LI, No. 6. In some lights it seems darker than the New Rockland slate but in others the difference is less pronounced. It might be said that there is a very slight cast of purple in this slate which is not seen in the New Rockland variety. The surface of the slates is scarcely as smooth as in the

New Rockland type and there is less reflection. This does not mean that the cleave is less perfect or that the sheets are not as flat, but that the surface is less glistening. No pyrite, worms or other flaws were observed in the specimens collected. The original bedding planes of the clay from which the slate has been formed are observable on some of the sheets in the different degree to which the glistening effect is developed. I am informed by Mr. Frazer that the Temiscouata slate splits better from the scallop than from the grain whereas the New Rockland slate splits best from the grain. This difference makes it easy to distinguish the two varieties in the made slates. The New Rockland slate shows the effect of splitting in an emphasis of the grain which runs down the long diagonal of the sheet. The Temiscouata slate, on the other hand, shows the effect of parting in wavy lines running across the sheet. The physical properties which were determined are given below. It was found impossible to prepare satisfactory cubes for crushing strength determinations as the stone always parted on the cleave during the process of cutting. This tendency is probably due to the fact that only surface material was available at the time of my visit. Under the corrosion test the stone seems to assume a slighter darker hue.

Specific gravity	2.802 2.801
Weight per cubic foot, lbs.	173.588 173.413
Pore space, per cent	0.783 0.825
Ratio of absorption, per cent, one hour	0.05 0.0591
" " " " " two hours	0.0772 0.0617
" " " " " slow immersion	0.233 0.196
" " " " " in vacuo	0.289 0.27
" " " " " under pressure	0.29 0.28
Coefficient of saturation, one hour	.24 .21
" " " two hours	.27 .22
" " " slow immersion	.8 .7
" " " in vacuo	.99 .99

PLATE XLVIII.

Temiscouata slate. Quarry of Frazer and Davis, Long lake, Temiscouata county, Que.

Transverse strength, lbs. per sq. in.[1]	3,610 [illegible],900
Loss on corrosion, grams per sq. in.	0.000466

An analysis of Temiscouata slate by Leverin gave the following results:—

	per cent
Silica	57.62
Alumina	21.66
Ferric oxide	0.14
Ferrous oxide	7.20
Calcium oxide	.90
Magnesian oxide	3.94
Combined water	4.06
Carbonic acid and undetermined matter (by difference)	4.34
Sulphur	0.144

Minor Slate Area.

Besides the more important belts already described, the occurrences of slate of possible economic value are numerous. The following list of those which seem to have the most promise may be found of use.

Brome county.

Geo. Sur. Can., Rep. 1894, p. 90 J. *Slate occurs on lots 4 and 5, range III, Brome township.* The slates are smooth, fissile and greenish and crop out on the stream below the woollen mill on the south branch of the Yamaska river. The formation dips northwesterly at 85° and is much cut by stringers of quartz. Similar slates occur on the road to Sweetsburg, three-eighths of a mile west of this stream.

In this vicinity a small quarry was opened some years ago on the property of Mr. H. Church of Sutton Junction and a small quantity of slate was obtained for local consumption. It is said that about 80 acres of workable slate occur along the strike of the belt. Little more than surface work has been done but fairly solid blocks were nevertheless obtained. The stock splits smooth with great facility.

Compton county.

Geol. Sur. Can., Rep. 1863, p. 830.—*Slates at Westbury on the St. Francis river in Westbury township.*

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[1] These results are scarcely worth recording as the slabs broke by splitting and showed mud on the cleavage planes. The material was obtained from the surface workings which had not been extended below the zone of frost action at the time of my visit.

Dorchester county.

Geol. Sur. Can., Rep. 1863-69, p. 44. –*Red slates in Frampton referred to the Lauzon formation.*

Geol. Sur. Can., Rep. 1888-89, p. 128 K.—*Purplish slate on lot 2, con X, Frampton.*

Bands of purple, red and green slates at many points in the slaty series west of the main anticline.

Megantic county.

Geol. Sur. Can., Rep. 1863, p. 830, *lot 14, range I, Halifax.*

Geol. Sur. Can., Rep. 1888-89, p. 128 K.—*Slates in township of Tring.*

Summary—Slates of the Province of Quebec.

Roofing slate has been quarried in the Eastern Townships since 1854 when a quarry was opened in the township of Cleveland. Some time later quarries were operated on the same belt at Melbourne and New Rockland and on other belts at Actonvale, Granby, Kingsey and other points. Although some of these quarries remained in commission for twenty years or more, they have all been abandoned with the exception of one at New Rockland. This quarry is still producing an excellent quality of dark grey slate a full description of which is given on page 237.

Quite recently a new quarry has been opened by Frazer and Davis at Long lake in Temiscouata county where a highly desirable dark grey slate occurs under excellent conditions for quarrying. The line of the Transcontinental railway passes across the property and it is hoped that slate will be ready for shipment by the time the road is open for traffic. A description of this slate is given on page 250.

CHAPTER X.

GLACIAL DRIFT.

Rivière du Loup.

Boulders of the Pre-Cambrian rocks are generously scattered over the country, in the vicinity of Rivière du Loup. As the local stone is not suited for building, boulders of gneiss and other stones have been employed quite extensively for structural purposes. The church of St. Francois Xavier de Fraserville, the Bank of Montreal, and many other buildings in Rivière du Loup are constructed of gneiss and granite of different colours. A large proportion of this stone was procured from Ste. Helène by Elzear Beaulieu. Other localities are St. Paschal and St. Phillipe de Norie (Plate XLIX).

Chaudière river.

At many places along the Chaudière river, large boulders of a greyish granitoid gneiss have been employed for building purposes. The church in St. Joseph is a good example of the application of this stone to architectural work of some pretensions.

Pre-Cambrian drift. Church of St. Francois Xavier de Fraserville. Rivière du Loup, Que.

CHAPTER XI.

RARER DECORATIVE MATERIALS.

Stones of gem quality are not known to occur in the Province of Quebec but a number of materials have been reported which are adapted to the making of small articles of a decorative character. While a full consideration of this subject does not properly fall within the scope of this report it seems advisable to call attention in a brief manner to the more important occurrences of substances of this kind. It is to be understood that none of these materials are being mined but that they represent possible sources of supply for the future. The decorative stones of this type may be conveniently considered under the following heads:

Handsome varieties of igneous and other rocks,
The feldspars,
Agalmatolite and related minerals,
Semi-precious stones.

Rocks.

Granites, etc.

A coarse grained rock made up of white feldspars, dark green pyroxene with brown sphene and occasionally with quartz occurs near Lachute, at Calumet falls, and in the township of Grenville (Geol. Sur. Can., Rep. 1863, p. 475).

A granite consisting of cleavable masses of white albite with quartz and mica occurs at the Lake of Three Mountains on the Rivière Rouge (Geol. Sur. Can., Rep. 1863, p. 477).

Brownish black porphyry with red feldspars occurs south of the road between ranges VII and VIII of Chatham on lot 8. A similar stone but with green and otherwise coloured base is found on lot 4, range VI of Grenville. As this locality appears to have attracted more attention than any other of the reported occurrences of this type of stone the outcrop was visited and a more extended account is given below.

Mrs. Wm. Kimball, Lot 4, Range VI, Grenville.

Concerning the stone on this property Sir Wm. Logan writes as follows: "The orthophyre, or quartziferous porphyry of Grenville, has a fine grained base, which appears to be an intimate mixture of orthoclase and quartz, coloured by oxide of iron, and varying in colour from dark green to various shades of red, purple and black, according to the state of oxidation of this metal. Throughout this paste are disseminated well-defined crystals of flesh red feldspar, apparently orthoclase; and, although less frequently, small grains of nearly colourless translucent quartz."[1]

The belt of porphyry referred to seems to extend about three-quarters of a mile in an east and west direction with a considerable width. The stone is easily accessible at many points but it is universally cut by diagonal fractures and is very hard and splintery. A hand specimen can scarcely be secured on account of this tendency to diagonal fracturing. It is difficult to forecast the possibilities at depth but as far as the formation is revealed it does not seem to be capable of yielding blocks of commercial size. The stone is very hard, however, and is probably adapted to the manufacture of small objects only. For this purpose, pieces of reasonable size can be procured.

The stone: No. 624.—The description given by Sir Wm. Logan and quoted above is a perfect account of the stone. The material polishes beautifully but it is of rather dark appearance and closely resembles some of the varieties from Chamcook in New Brunswick which were described on page 206 of the second volume of this report.

Porphyry of a similar character also occurs on lot 8, range VIII of Chatham.

A quartziferous porphyry occurs on lots 3 and 4 of ranges V and VI of Grenville. (Geol. Sur. Can., Rep. 1863, p. 832).

Pebbles and rolled boulders of anorthosite showing feldspars with occasional iridescent points are found along the Ottawa river, more particularly in Grenville (Geol. Sur. Can., Rep. 1863, p. 833).

Garnetiferous gneisses occur in Portland township and in Rawdon. Concerning this latter locality Dr. Adams writes as follows:

"Bands of highly garnetiferous gneiss are found at many localities within this area, associated with rusty-weathering gneisses, quartzite and crystalline limestone. At two localities these are associated with bands of granular garnet rock, sufficiently thick to be of economic value.

"The first of these localities is on the rear of lot 20 of range VII of the township of Rawdon, where several beds of a rock composed very largely of a red garnet, occur interstratified with a fine grained garnetiferous gneiss and white quartzite, the largest of the garnet beds being about two feet thick. Some portions of these beds consist of almost pure garnet, while in others this mineral is mixed with a little quartz, feldspar and dark mica." (Geol. Sur. Can., Rep. 1895, p. 150 J).

Granite porphyries and porphyritic granites form a considerable portion of Stoke mountain in Richmond county (Geol. Sur. Can., Rep. 1902-3, p. 310A.)

Garnet rock also occurs at St. Jerome. Large red garnets in a white oligoclase gneiss occur on Lake Simon on the Rouge river.

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[1] Geol. Sur. Can., Rep. 1863, p. 654.

The granulite dykes and masses that are found cutting the serpentines of the asbestos district may prove a source of a white decorative stone of value. Deposits of this kind are found in Megantic and Wolfe counties in considerable abundance.

Granites and porphyritic granites of possible value as decorative material are reported from Table Top mountain and the Ste. Anne river in the peninsula of Gaspé. (Geo. Sur. Can., Rep. 1882-84, p. 21 F.

A fine grained mixture of pale green epidote with quartz is found on the Matanne river. This rock, which forms great masses in the Shickshock mountains, is very hard; and as it receives a fine polish and has a bright yellowish green colour it might be used as an ornamental stone. (Geol. Sur. Can., Rep. 1863, p. 834).

A fine grained gneiss with red feldspar and with pistachio-green epidote in thin reticulating veins occurs at the lowest falls of the Mingan river. (Geol. Sur. Can., Rep. 1863, p. 37.).

Jasper.

"Beds of jasper occur at various places in this series. At Rivière Ouelle there is a band of red and green jasper, interstratified with unaltered shales of the Quebec group. It contains veins of chalcedony; and it appears to owe its colour to disseminated hematite. Near to Sherbrooke, in the metamorphic region, there is also a bed of red jasper, which contains hematite and passes into jaspery red iron ore.

"In the parts exposed the Sherbrooke bed does not appear to be sufficiently compact to be wrought for ornamental purposes. The Rivière Ouelle jasper is compact and uniform in its texture and receives a good polish; in some parts, the reddish brown base is marked by clouds of brilliant red (Geol. Sur. Can., Rep. 1863, pp. 599 and 834.).

"On the same property (lot 15, range X, Hull) a belt of jasper can be traced for 150 yards. It probably parts the quartzite above mentioned from an orthoclase rock, and varies in thickness from one to two feet. It is bright red to chocolate brown, and portions are mottled with yellow, the latter colour often prevailing. Blocks of fair size might easily be obtained with little outlay. It would constitute, when polished, a handsome material for ornamental purposes. Loose blocks of it are of common occurrence on lot 14, range VIII of the same township." (Geol. Sur. Can., Rep. 1882-4, p. 166).

Fuchsite Schist.

A very handsome rock of a bright green colour occurs on lots 14 and 15, range IX of Bolton. Mr. Alex. McLean has kindly furnished me with the following account of the occurrence. "The stone occurs outcropping as a considerable sheet of variable thickness but apparently ranging from 5 to 15 feet. It is included in a series of older schistose rocks with which it dips at a low angle in a southeasterly direction. Where the overlying schist has been removed by erosion, as occurs in several places, there are considerable areas of the green rock with practically horizontal exposure."

The rock probably represents a peridotite intrusion which has since suffered considerable alteration. The presence of quartz in veins and in a finely disseminated condition is a marked feature of this change. The stone consists essentially of the green chromiferous mica, *fuchsite*, and quartz. The polished surface is of handsome appearance and is shown in Plate LI, No. 16. The material is hard and does not receive a high polish owing to the great difference in hardness of the component minerals.

Feldspar.

The beautiful iridescent variety of feldspar, known as *labradorite* on account of its occurrence at St. Pauls island on the coast of Labrador, occurs at Cap Mahue in the tenth range of Abercrombie. This occurrence is thus described by Sir Wm. Logan: "Here, in a fine grained lavender-blue labradorite rock are imbedded cleavable masses of the feldspar, sometimes several inches in diameter, and exhibiting blue, golden green, and bronze green reflections. The rolled masses of anorthosite or labradorite rocks which are common along the shores of the Ottawa, especially in the vicinity of Grenville, often contain small portions of the opalescent feldspar. The mass of the rock receives a high polish, and presents a clouded dark greyish green ground, with spots of an opalescent blue, forming an ornamental stone, which may be applied to the same uses as the polished porphyries and granites." (Geol. Sur. Can., Rep. 1863, p. 833).

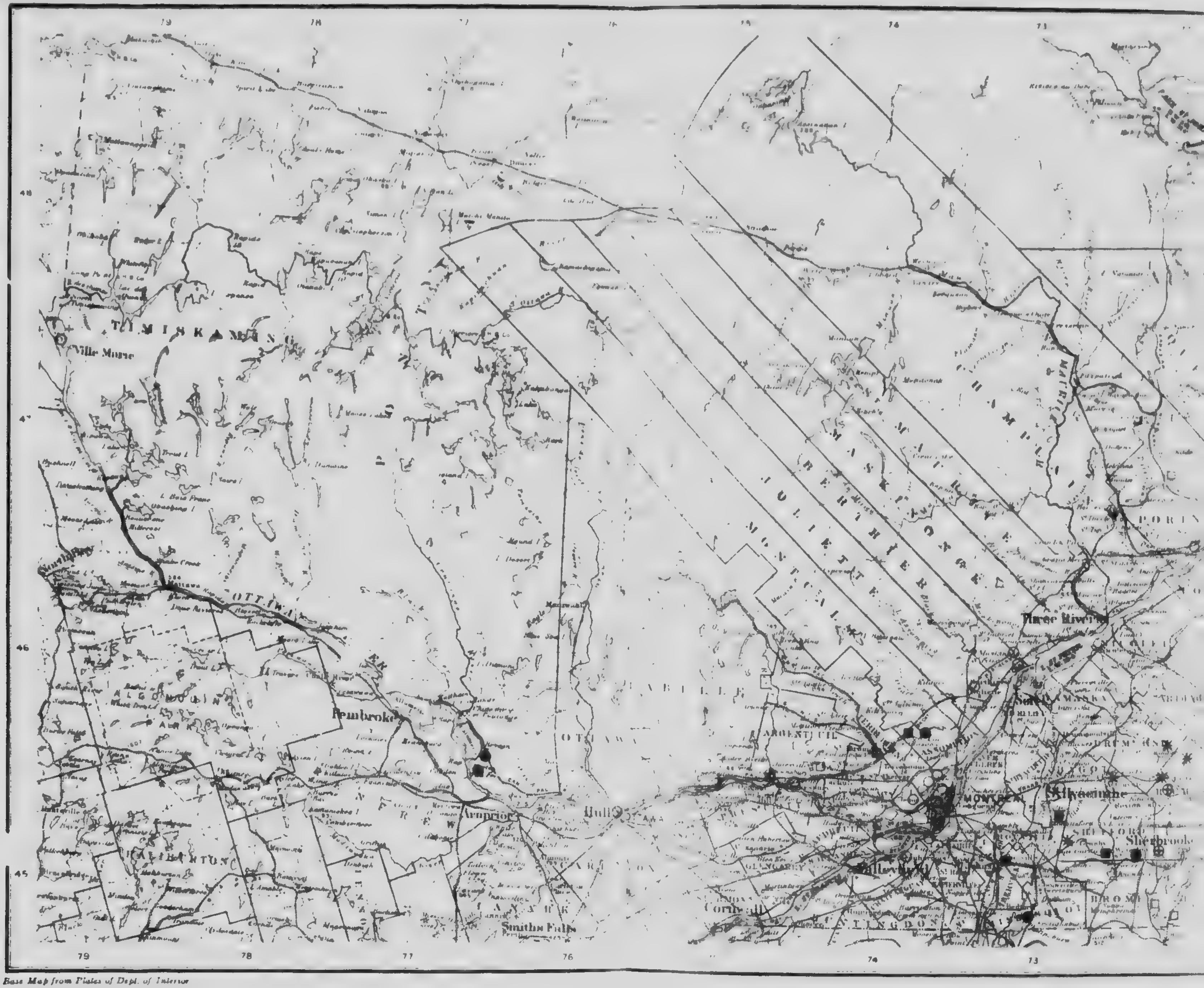
Large striated cleavable masses of reddish feldspar are found at Château Richer but they do not seem to have any economic value.

The variety of feldspar known as microcline occurs in the township of Hull and red orthoclase in Templeton. The latter deposit is on the property of H. Beauchamp in range III of Templeton east. Here a belt of coarse pegmatite strikes east and west with a width of about 50 feet. Some work has been done and a quantity of flesh red orthoclase obtained. The property does not look promising as a producer of decorative material.

Peristerite, an opalescent variety of albite, is reported from Villeneuve, Ottawa county.

The anorthosite of Morin and Mille Iles may in places contain labradorite of semi-precious quality but the great bulk of the formation does not show the iridescent variety.

DEPARTMENT OF MINES MINES BRANCH



Base Map from Plates of Dept. of Interior

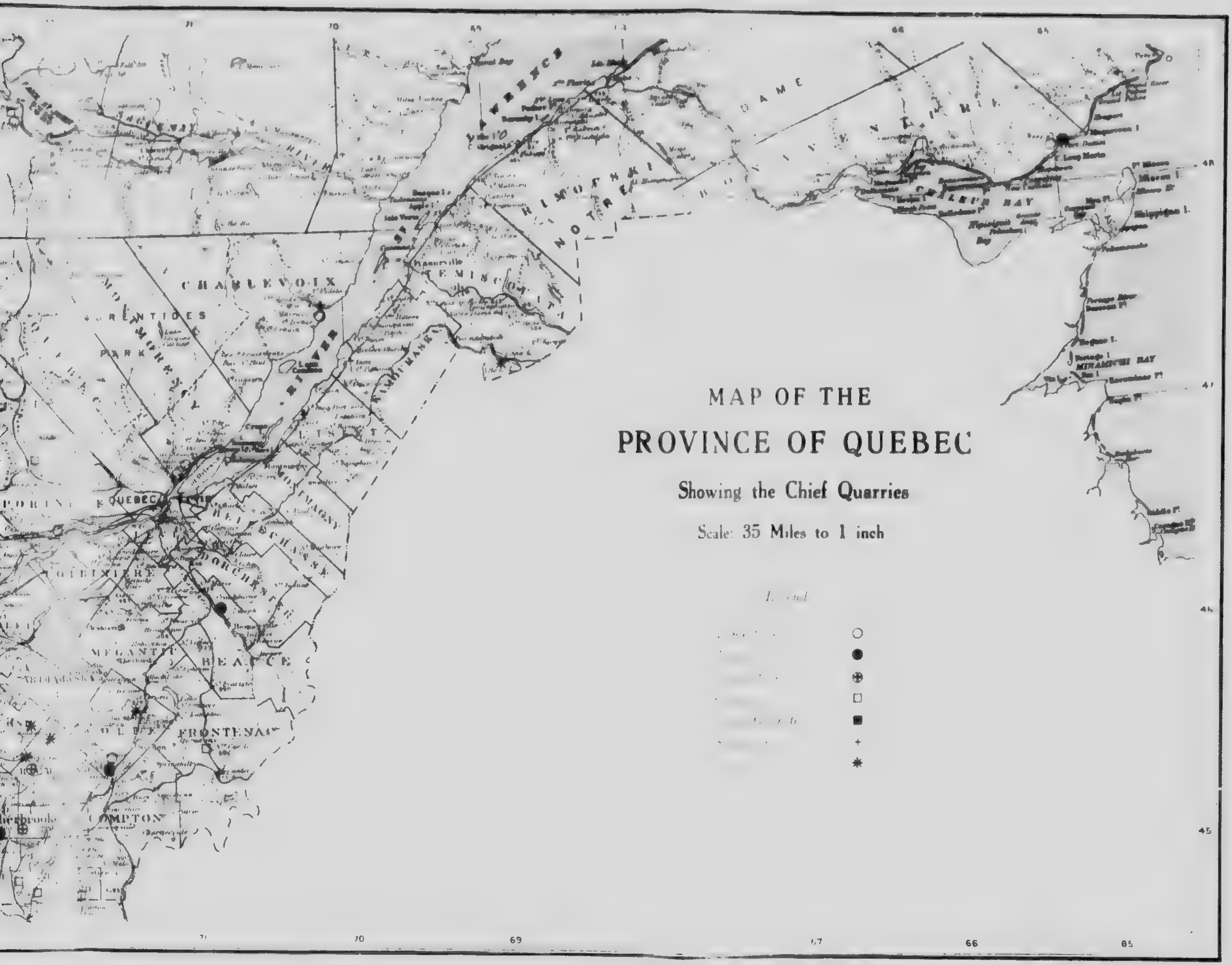

MAP OF THE
PROVINCE OF QUEBEC
Showing the Chief Quarries
Scale: 35 Miles to 1 inch
CHARLEVOIX
LAURENTIDES PARK
QUEBEC
MONTMORENCY
RIMOUSKI
TEMISCOUATA
KAMOURASKA
L'ISLET
MONTMAGNY
BELLECHASSE
DORCHESTER
LOTBINIÈRE
MEGANTIC
BEAUCE
FRONTENAC
COMPTON
Sherbrooke
BONAVENTURE
CHALEUR BAY
MIRAMICHI BAY
ST. LAWRENCE RIVER
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FIG. 12

Agalmatolite.

Agalmatolite or figure stone is the name given to a soft mineral used by the Chinese for carving into ornamental objects. Several minerals possess the same properties and in consequence some confusion has arisen. For our purposes, however, it may be said that substances of this character have been reported in Quebec, but that none of them show evidence of being of economic importance.

The localities mentioned are:—near Famine river, in the parish of St. Francis, Beauce county, where the mineral occurs in honey-yellow, translucent masses; on lot 15 of range I of Stanstead; and at St. Nicholas in Levis county.

Rensselaerite or pyrallolite is a related mineral occurring in Grenville, Hull, etc. Museum specimens have been cut from very handsome material which occurs on lot 14, range IX, Hull.

Semi-precious Stones.

A green compact variety of fluorite in veins of white calcite occurs in the Trenton sandstone at Murray Bay and Baie St. Paul. Dr. Kunz is of the opinion that this material could be worked into a beautiful ornamental stone.

Agates from pebbles in the Bonaventure formation are found [illegible] the Gaspé coast and are known as Gaspé pebbles.

Green tourmaline crystals are found in Chatham, and the red variety *rubellite*, in Villeneuve township. Fine translucent brown crystals are found in a flesh-red limestone at Calumet Falls.

Large slabs of a beautiful yellow colour may be cut from the scapolite bearing rock in Grenville (Geol. Sur. Can., Rep. 1888-89, p. 157 K.).

A full list of the semi-precious stones of Canada is given by Dr. Kunz in Part S of the Report of the Geological Survey of Canada for 1887-8. As this subject can scarcely be considered within the scope of the present work, the reader is referred to the above report for full information on the semi-precious and precious stones of Quebec.

Plate L.

No. 1—Trenton limestone, Chateauvert's quarry, St. Marc des Carrières, Que. (575)
No. 2—Trenton limestone, Lauzon's quarry, Joliette, Que. (601)
No. 3—Trenton limestone, Lauzon's quarry (town), Joliette, Que. (599)
No. 4—Chazy limestone, Otis' quarry, Grande Ligne, Que. (706)
No. 5—Trenton limestone, Labelle's quarry, St. Francois de Salles, Que. (594)
No. 6—Chazy limestone, Dagenais' quarry, Village Belanger, Que. (605)
No. 7—Trenton limestone, Wright and Company's quarry, Hull, Que. (629)
No. 8—Chazy limestone, St. George's quarry, Grande Ligne, Que. (709)
No. 9—Chazy limestone, Villeray Quarry Co., Montreal, Que. (588)
No. 10—Trenton limestone, Corbeil's quarry, Côte St. Michel, Montreal, Que. (596)
No. 11—Chazy limestone, Prison quarry, Bordeaux, Que. (606)
No. 12—Trenton limestone, Martineau's quarry, Montreal, Que. (584)
No. 13—Trenton limestone, Standard Quarry Co., St. Vincent de Paul, Que. (590)
No. 14—Chazy limestone, Legacé's quarry, Cartierville, Que. (598)
No. 15—Chazy limestone, Bigras' quarry, Village St. Martin, Que. (604)
No. 16—Trenton limestone, Laviolette's quarry, Hull, Que. (633)

Plate [illegible].

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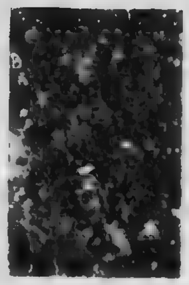
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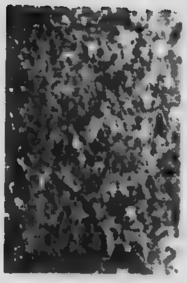
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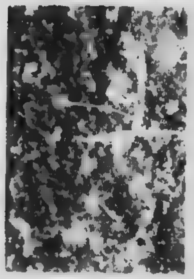
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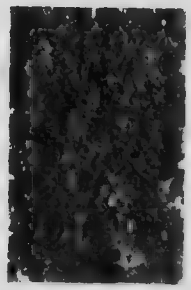
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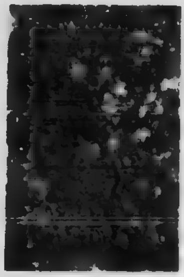
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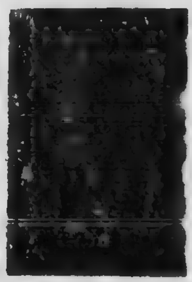
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Plate LI.

No. 1—Trenton limestone, Quebec Brick Co., Beauport, Que. (574)
No. 2—Trenton limestone, Rogers and Quirk, Montreal, Que. (583)
No. 3—Silurian argillaceous limestone, Millstream, Que. (825)
No. 4—"Banc rouge," Morrison Quarry Co., Montreal, Que. (581)
No. 5—Sillery sandstone, Dusseault's quarry, Levis, Que. (571)
No. 6—Slate, Frazer and Davis, Long lake, Temiscouata county, Que. (840)
No. 7—Slate, New Rockland Slate Co., New Rockland, Que. (762)
No. 8—Slate, Actonvale, Que. (830)
No. 9—Trenton sandstone, Malbaie, Que. (802)
No. 10—Devonian sandstone, Lajoie's quarry, Causapscal, Que. (826)
No. 11—Carboniferous sandstone, Busteed's quarry, Pointe à Bourdeau, Que. (822)
No. 12 Niagara dolomitic sandstone, Routly and Summers, Piché point, Lake Timiskaming Que. (939)
No. 13—Niagara arenaceous dolomite, Burnt island, Lake Timiskaming, Que. (938)
No. 14—Silurian marble, Dominion Lime Co., Lime Ridge, Que. (574)
No. 15—Vert royal marble, Dominion Marble Co., South Stukely, Que. (737)
No. 16—Fuchsite schist, Bolton township, Que.

Plate 11

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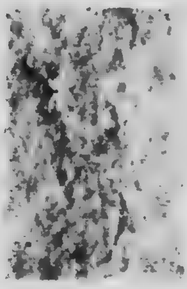
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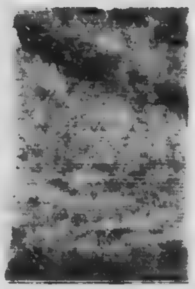
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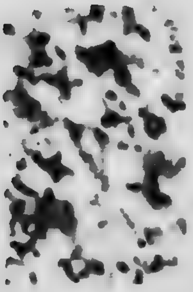
Plate LII.

No. 1—Grey granite, Moir's quarry, Stanstead, Que. (749)
No. 2—Grey granite, Frontier Granite Co., Stanhope, Que. (751)
No. 3—Granite, Voyer's quarry, Rivière à Pierre, Que. (578)
No. 4—Granite, Perron's quarry, Rivière à Pierre, Que. (576)
No. 5—Nordmarkite, Brome mountain, township of East Farnham, Que. (930)
No. 6—Granite, Lacombe and D'Allaire, St. Sebastien, Que. (788)
No. 7—Essexite, Yamaska mountain, Canadian Pacific Railway's quarry. (837)
No. 8—Black granite, Danville Granite and Asbestos Co., Danville, Que. (776)
No. 9—Essexite (andose), Mount Johnson Quarry Co., Mount Johnson, Que. (702)
No. 10—Essexite (essexose), Mount Johnson Quarry Co., Mount Johnson, Que. (704)
No. 11—Red marble, J. Minard, Orford mountain, Que. (732)
No. 12—Red marble, Port Daniel, Que. (816)
No. 13—Partially serpentenized peridotite, township of Cleveland, Que. (772)
No. 14—Massive dark green serpentine, Kingsbury, Que. (927)
No. 15—Green serpentine, with lighter veins, Orford mountain, Que. (781)
No. 16—Serpentine marble, township of Grenville, Que. (623)

Plate III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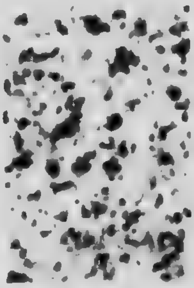
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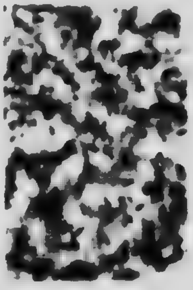
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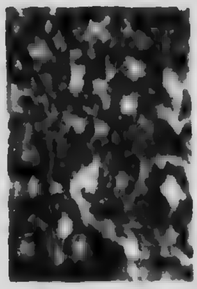
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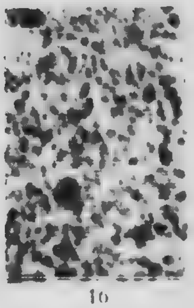
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APPENDIX I.

TABLE I.

The Specific Gravity, Weight per Cubic Foot, Pore Space, Ratio of Absorption, and Coefficient of Saturation of Quebec Building Stones.

LIMESTONES.

No.	Owner	Area	Specific Gravity	Weight per cubic foot	Pore space per cent	Ratio of Absorption per cent	Coefficient of Saturation
583	Rogers and Quick	Montreal	[illegible]	[illegible]	[illegible]	0.289	0.908
584	Morrison Quarry Co.	Montreal	2.704	168.022	0.455	0.169	[illegible]
			2.707	168.486	0.35	0.1274	0.94
588	Villeray Quarry Co.	Montreal	2.712	168.663	0.394	0.1456	0.91
596	Francois Corbeil	Montreal Côte St Michel	2.707	168.345	0.38	0.141	0.717
600	Montreal Prison	Montreal, Bordeaux	2.727	168.31	1.136	0.423	0.942
598	Joseph Legacé	Montreal, Cartierville	2.722	169.[illegible]	0.462	0.1762	0.97
604	Damien Bigras	Montreal, Village St. Martin	2.722	169.[illegible]	0.434	0.1603	0.973
605	Gregoire Dagenais	Montreal, Village Belanger	2.713	168.72	0.378	0.1402	0.927
590	Standard Quarry Co.	Montreal, St. Vincent de Paul	2.709	168.15	0.568	0.211	[illegible]
594	Felix Labelle	Montreal, St. Francois de Salles.	2.708	168.253	[illegible]	0.1742	0.936
575	Georges Chateauvert	St. Marc des Carrières.	2.703	167.654	0.642	[illegible]	0.847
599	Edouard Lauzon	Joliette	2.705	167.271	0.944	0.353	0.857
601	Edouard Lauzon.	Joliette	2.691	163.326	2.775	1.06	[illegible]
629	Wright & Co.	Hull.	2.71	167.742	0.847	0.315	0.81
635	David Laviolette.	Hull.	2.713 2.715 2.715	168.519	0.4975	0.184	1.00
700	Narcisse Lord	St. Johns	2.713	169.224	0.081	0.0298	0.76
706	Otis	St. Johns-Grande Ligne	2.711	168.271	0.571	0.2122	0.83
709	Alexander St. George	St. Johns-Grande Ligne	2.706	168.174	0.444	0.1651	0.87
574	Quebec Brick Co.	Beauport	2.706	168.283	0.38	0.1425	0.444
759	William Bentley.	Dudswell	2.709	167.411	[illegible]	0.3755	0.88
825	....	Millstream.	2.737	168.902	[illegible]	0.401	0.73
831	Pierre Dumas	St. Dominique.	2.764	172.184	0.209	0.0758	0.44

SANDSTONES.

No.	Owner	Area	Specific Gravity	Weight per cubic ft., lbs.	Pore-space per cent.	Ratio of Absorption, per cent.	Coefficient of Saturation
571	J. T. Dussault	Quebec Levis	2.71	166.674	1.478	0.553	0.893
609	Euclide Mompetit	Beauharnois .	2.657	161.775	2.46	0.95	0.85
822	T. R. Busteed	Bourdeau	2.724	150.731	11.36	4.71	0.66
			2.702	150.29	10.9	4.53	0.7
826	A. Lajoie	Causapscal.	2.689	160.64	3.15	1.21	0.94

GRANITES.

No.	Owner	Area	Specific Gravity	Weight per cubic ft., lbs.	Pore-space per cent.	Ratio of Absorption, per cent	Coefficient of Saturation
743	James Brodie	Stanstead .	2.688	166.662	0.738	0.277	0.78
744	Samuel Norton	Stanstead..	2.683	166.048	0.861	0.336	0.82
749	G. W. Moir	Stanstead.	2.692	166.778	0.758	0.285	0.81
751	Frontier Granite Co.	Stanhope	2.646	163.012	1.312	0.503	0.79
788	Lacombe and D'Allaire	Megantic, St. Sebastien	2.682	165.663	1.053	0.397	0.71
617	Joseph Cyr	St. Jerome, St. Canut.	2.641	164.171	0.422	0.162	0.84
839	James Brodie	Ottawa .	2.665	165.276	0.655	0.247	0.82
619	Laurentian Granite Co.	Argenteuil	2.651	164.48	0.613	0.232	0.714
576	Joseph Perron.	Rivière à Pierre	2.76	171.686	0.355	0.129	0.746
578	Fortunat Voyer	Rivière à Pierre	2.694	168.176	0.406	0.151	0.75
579	August Bernier	Roberval	2.653	164.959	0.397	0.151	0.764
580	August Bernier	Roberval ..	2.789	171.363	0.432	0.156	0.853

BLACK GRANITES, ETC.

No.	Owner	Area	Specific Gravity	Weight per cubic ft., lbs.	Pore-space per cent.	Ratio of Absorption, per cent.	Coefficient of Saturation
581	Morrison Quarry Co .	Montreal	2.548	158.85	0.125	0.0497	0.476
702	Mount Johnson Quarry Co	Mount Johnson	2.836	176.6	0.249	0.0883	0.65
703	Mount Johnson Quarry Co. .	Mount Johnson	2.876	179.02	0.288	0.1005	0.75
704	Mount Johnson Quarry Co	Mount Johnson	2.844	176.896	0.362	0.1277	0.72
837	Can. Pac. Railway	Yamaska Mountain.	2.757	170.401	0.992	0.3645	0.76
776	Danville Granite and Asbestos Co.	Danville	2.686	167.076	0.358	0.1336	0.72

MARBLES.

No.	Owner	Area	Specific Gravity	Weight per cubic ft., lbs.	Pore-space per cent.	Ratio of Absorption, per cent.	Coefficient of Saturation
642	Pontiac Marble and Lime Co.	Portage du Fort.	2.867	178.612	0.203	0.071	0.95
			2.868	178.543	0.241	0.084	0.90
644		Portage du Fort.	2.739	170.426	0.21	0.0741	0.92
713	Missisquoi Lautz Corp	Missisquoi	2.716	169.273	0.163	0.06	1.00
714	Missisquoi Lautz Corp	Missisquoi	2.714	169.161	0.155	0.057	1.00
736	Dominion Marble Co.	South Stukely.	2.781	173.050	0.323	0.1167	1.00

SLATES.

No.	Owner	Area	Specific Gravity	Weight per cubic ft., lbs.	Pore-space per cent.	Ratio of Absorption, per cent.	Coefficient of Saturation
762	New Rockland Slate Co	Melbourne.	2.752	170.97	0.481	0.178	0.58
830		Actonvale.	2.801	173.045	1.034	0.373	0.76
840	Frazer and Davis	Temiscouata	2.802	173.588	0.783	0.28	0.8
			2.801	173.413	0.825	0.29	0.7

TABLE II.

The Ratio of Absorption and the Coefficient of Saturation under different conditions one hour soaking, two hours soaking, slow immersion and long soaking, in vacuo, and under pressure.

LIMESTONES

No.	OWNER	Area	Ratio of Absorption, per cent.					Coefficient of Saturation			
			One hour	Two hours	Slow immersion	In vacuo	Under pressure	One hour	Two hours	Slow immersion	In vacuo
583	Rogers and Quirk ..	Montreal	.1651	.1985	.2625	289	289	572	688	908	1.00
584	Morrison Quarry Co	Montreal	.0938	.1172	1486	......	169	555	695	879	.....
			.0825	.0890	1122	1245					..
			0735	.0805	.1202	1274	.1274	57	68	94	1 00
588	Villeray Quarry Co	Montreal	.0978	.108	.1325	1392	.1456	67	743	91	957
596	Francois Corbeil	Montreal	.0703	.0912	108	.117	.141	498	647	.717	.832
606	Montreal Prison	Montreal	0963	.1255	.398	417	423	227	297	942	.986
598	Joseph Legacé	Montreal	.1024	.1244	.1708	.1726	.1762	.582	707	97	.98
604	Damien Bigras ..	Montreal	.095	.119	.156	1603	.1603	.593	743	973	1 00
605	Gregoire Dagenais .	Montreal	.098	.1016	.1297	.1402	1402	.698	726	927	1 00
590	Standard Quarry Co	Montreal	.092	1093	.208	.208	.211	.435	518	985	.985
594	Felix Laielle........	Montreal	.107	128	.1632	.1632	.1742	615	.737	936	.936
575	Georges Chateauvert	St. Marc	.139	.139	.202	.209	.239	582	582	847	.875
599	Edouard Lauzon	Joliette	.253	.264	.3025	.313	353	.717	748	857	888
691	Edouard Lauzon	Joliette	.302	.321	.704	.73	1 06	.285	33	663	.685
629	Wright and Co. .	Hull	.191	.223	.273	.288	.315	607	708	817	.914
633	David Laviolette	Hull	.0995	.133	.1847	.1847	.1847	.538	721	1 00	1.00
700	Narcisse Lord	St. Johns	.0074	.0097	.0229	.0298	.0298	.25	33	76	1 00
706	Otis..........	St. Johns	.1482	1482	.1771	.1948	.2122	.7	7	83	.96
709	Alexander St. George	St. Johns	.1062	.1062	.1432	.1432	.1651	.64	.64	87	87
574	Quebec Brick Co	Beauport	.0114	.0343	.0635	.0973	.1425	08	.243	.444	.682
759	William Bentley	Dudswell	.1988	2168	.333	3535	.3755	.53	.57	88	94
825		Millstream	.1075	.131	.2925	.351	.401	.26	.32	.73	87
831	Pierre Dumas.	St.Dom'que	.0068	.0089	.0333	.0518	0758	.09	.12	.44	.68

SANDSTONES

No.	OWNER	Area	Ratio of Absorption, per cen. One hour	Two hours	Slow immersion	In vacuo	Under pressure	Coefficient of Saturation One hour	Two hours	Slow immersion	In vacuo
571	J. T. Dussault	Que.-Levis	246	.461	.494	.514	553	445	588	893	93
609	Euclide Mompetit	Beauharnois	834	848	.874	95					
			623	.683	.813	85	.95	65	72	85	89
822	T. R. Busteed	Bourdeau	98	1.29	3.11	4.35	4.71	20	28	66	88
			1.005	1.223	3.2	4.48	4.53	22	27	7	96
826	A. Lajoie	Causapscal	391	581	1.136	1.165	1.21	323	354	94	964

GRANITES

No.	OWNER	Area	Ratio of Absorption, per cent One hour	Two hours	Slow immersion	In vacuo	Under pressure	Coefficient of Saturation One hour	Two hours	Slow immersion	In vacuo
743	James Brodie	Stanstead	1812	1812	.2175	2265	277	65	65	75	84
744	Samuel Norton	Stanstead	2159	.2285	2785	286	.33	.65	69	82	86
749	G. W. Moir	Stanstead	177	.208	.231	252	2846	62	73	81	88
751	Frontier Granite Co.	Stanhope	34	3688	402	44	503	67	75	79	87
788	Lacombe and D'Allaire	Megantic	.2442	2442	285	3332	.3975	61	61	.71	84
617	Joseph Cyr	St. Jerome	.1233	1335	.1345	.1452	162	.763	.823	84	907
839	James Brodie	Ottawa	.162	.162	2045	227	247	65	65	82	89
619	Laurentian Granite Co.	Argenteuil	1466	1466	.1659	1858	.232	63	63	714	80
576	Joseph Perron	Rivière à Pierre	0867	.0867	.0962	.0962	129	.67	67	746	736
578	Fortunat Voyer	Rivière à Pierre	1134	.1134	.1134	131	.151	75	75	75	975
579	August Bernier	Roberval	1065	.1065	.1152	121	.151	.706	706	764	802
580	August Bernier	Roberval	.133	.133	.133	.133	.156	.853	853	853	.853

BLACK GRANITES, ETC

No.	OWNER	Area	Ratio of Absorption, per cent					Coefficient of Saturation			
			One hour	Two hours	Slow immersion	In vacuo	Under pressure	One hour	Two hours	Slow immersion	In vacuo
581	Morrison Quarry Co	Montreal	.0237	.0237	.0237	0366	0497	476	476	.476	736
702	Mount Johnson Quarry Co	Mt.Johnson	0423	0423	0572	0613	0883	48	48	65	69
703	Mount Johnson Quarry Co	Mt.Johnson	.047	.052	.0763	0763	1005	46	51	75	75
704	Mount Johnson Quarry Co	Mt.Johnson	0692	0801	.0928	1071	.1277	54	.62	72	84
837	Can. Pac. Railway	Mt.Yamaska	2295	.2295	.279	.312	3645	.62	62	76	.85
776	Danville Granite & Asbestos Co	Danville	0763	0856	097	0991	1336	57	64	72	74

MARBLES

No.	OWNER	Area	Ratio of Absorption, per cent.					Coefficient of Saturation			
			One hour	Two hours	Slow immersion	In vacuo	Under pressure	One hour	Two hours	Slow immersion	In vacuo
642	Pontiac Marble and Lime Co	Portage du Fort	0482	0482	0761	.0761	.084	6	6	9	9
			0422	0422	0681	071	071	6	6	.95	1 0
641		Portage du Fort	0492	0523	0685	0727	0762	.64	68	89	95
713	Missisquoi Lautz Corp	Missisquoi	0281	0322	0602	.0602	0602	46	53	1 00	1 00
714	Missisquoi Lautz Corp	Missisquoi	0419	0476	0573	0573	0573	73	83	1 00	1 00
736	Dominion Marble Co	S Stukely	068	0763	1167	1167	1167	58	65	1 00	1 00

SLATES

No.	OWNER	Area	Ratio of Absorption, per cent					Coefficient of Saturation			
			One hour	Two hours	Slow immersion	In vacuo	Under pressure	One hour	Two hours	Slow immersion	In vacuo
762	New Rockland Slate Co	Melbourne	0125	0223	105	1273	178	07	12	58	71
830		Actonvale	141	168	2815	345	373	37	45	76	92
840	Frazer and Davis	Temiscouata	.0593	0772	233	289	29	24	27	8	99
			0591	.0617	196	27	28	21	22	7	99

TABLE III.

The Crushing Strength of Quebec Building Stones.

LIMESTONES.

No.	Owner	Area	Formation	Crushing strength, lbs. per sq. in.	Remarks
583	Rogers and Quirk	Montreal	Trenton	24,350	Slight cracks before collapse; imperfect lower pyramid.
584	Morrison Quarry Co.	Montreal	Trenton	22,400	Shearing lines before collapse; good lower pyramid.
588	Villeray Quarry Co	Montreal	Trenton	21,610	Shearing lines before collapse; good lower pyramid.
596	Francois Corbeil	Montreal, Côte St. Michel	Trenton	19,520	General break up just before collapse; lower pyramid.
606	Montreal Prison	Montreal, Bordeaux	Chazy	19,550	General break up just before collapse; lower pyramid.
598	Joseph Legacé.	Montreal, Cartierville.	Chazy	20,500	Small vertical lines just before collapse; small vertical wedges.
604	Damien Bigras	Montreal, Village St. Martin	Chazy	22,350	Sudden collapse, but one fine line appeared before; lower pyramid.
605	Gregoire Dagenais	Montreal, Village Belanger	Chazy	24,450	General break up before collapse; poor lower pyramid.
590	Standard Quarry Co.	Montreal, St. Vincent de Paul	Trenton	22,350	Fine cracks throughout just before collapse; lower pyramid.
594	Felix Labelle	Montreal, St. Francois de Salles	Trenton.	20,450	Corner cracked off before collapse; small lower pyramid.
575	Georges Chateauvert	St. Marc des Carrières	Trenton	17,980	Small lines before collapse; cracks all through just before.
599	Edouard Lauzon	Joliette.	Trenton.	16,030	Sudden collapse; high lower pyramid, small upper cone.
601	Edouard Lauzon	Joliette	Trenton	15,350	Sudden collapse, high lower pyramid, small upper cone.

LIMESTONES—*Continued*

No.	Owner	Area	Formation	Crushing strength, lbs per sq. in.	Remarks
629	Wright & Co.	Hull	Trenton	20,580	Crack just before collapse, good lower pyramid
633	David Laviolette	Hull	Trenton	25,100	General break up just before collapse; flat lower pyramid
700	Narcisse Lord	St. Johns	Trenton	31,300	General break up before collapse.
706	Otis	St. Johns, Grande Ligne	Chazy.	19,180	Fine cracks before collapse; irregular upper pyramid.
709	Alexander St. George	St. Johns, Grande Ligne	Chazy	20,860	General break up just before collapse.
574	Quebec Brick Co	Beauport	Trenton	44,400	General break up before collapse; small fragments
759	William Bentley	Dudswell	Silurian	29,200	Crack before collapse; poor lower pyramid.
825		Millstream.	Silurian	20,280	Previous cracks in specimen; small crack appeared early; result probably low.
831	Pierre Dumas	St. Dominique	Chazy	26,150	Cracked shortly before collapse; sharp wedges.

SANDSTONES.

No.	Owner	Area	Formation	Crushing strength, lbs per sq. in.	Remarks
571	J. T. Dussault.	Quebec Levis	Sillery .	27,000	Slight crack before collapse; lower wedges.
609	Euclide Mompetit	Beauharnois	Potsdam-Beekmantown	28,100	Poor test: cracked at one corner and failed from side: undoubtedly low.
822	T. R. Busteed	Bonaventure	Carboniferous. . .	14,970	Sudden collapse, long upper pyramid.
826	A. Lajoie	Causapscal	Devonian. .	31,200	Slight failure just before collapse; lower wedges.

GRANITES.

No	Owner	Area	Formation	Crushing strength, lbs per sq. in	Remarks
743	James Brodie	Stanstead.	Igneous.	24,900	Slight crack just before collapse; flat lower wedges.
744	Samuel Norton	Stanstead.	Igneous	23,770	Slight crack just before collapse; flat lower wedges.
749	G. W. Moir	Stanstead.	Igneous	27,380	Slight crack just before collapse; small wedges.
754	Frontier Granite Co.	Stanhope.	Igneous	28,500	Spit from sides just before collapse; small fragments.
788	Lacombe and D'Allaire	St Sebastien.	Igneous	36,820	Crack just before collapse; exploded; fragments.
617	Joseph Cyr	St. Jerome St. Canut.	Igneous	39,000	Fine lines throughout just before collapse; fragments.
839	James Brodie	Ottawa	Igneous	33,100	Failed from one side; probably a little low.
619	Laurentian Granite Co.	Argenteuil	Igneous	37,590	Chipped at corners; small fragments. Duplicates vary 3000 lbs.
576	Joseph Perron.	Rivière à Pierre	Igneous	24,730	Small cracks just before collapse; small fragments
578	Fortunat Voyer	Rivière à Pierre	Igneous.	29,600	Failed under sustained load; probably a little low; wedges.
579	August Bernier	Roberval	Igneous	30,650	Fine lines throughout before collapse; small wedges.
580	August Bernier	Roberval	Igneous.	28,150	Chipped just before collapse; small fragments.

BLACK GRANITES, ETC.

No.	Owner	Area	Formation	Crushing strength, lbs. per sq. in.	Remarks
581	Morrison Quarry Co.	Montreal	Igneous	45,700	Specimen showed previous flaws; splinters shot off from sides and corners, small fragments
702	Mount Johnson Quarry Co	Mount Johnson	Igneous	40,900	Exploded; fragments only.
703	[illegible]unt [illegible]son [illegible]y Co	Mount Johnson	Igneous	3[illegible],500	Exploded after slight preliminary crack fragments.
704	Mount Johnson Quarry Co.	Mount Johnson	Igneous	41,300	Exploded after slight pre[illegible]ary crack, powder
837	Can. Pac Railway	Yamaska Mountain	Igneous	29,420	Split a little from side before collapse; wedges
[illegible]76	Danville Granite and Asbestos Co	Danville	Igneous	34,400	Fine cracks throughout just before collapse; small [illegible]

MARBLES.

No.	Owner	Area	Formation	Crushing strength, lbs. per sq. in.	Remarks
642	Pontiac Marble and Lime Co.	Portage du Fort.	Grenville	21,850	Showed failure throughout before collapse; sulphurous odor; powdered.
644		Portage du Fort	Grenville.	21,200	Showed numerous fine lines before collapse; powdered.
713	Missisquoi-Lautz Corp	Missisquoi	Chazy	20,380	Slight irregular cracks before collapse; lower pyramid.
714	Missisquoi-Lautz Corp	Missisquoi	Chazy	20,360	Spread just before collapse; lower pyramid.
736	Dominion Marble Co.	S. Stukely	Pre-Cambrian.	17,450	Filled with fine lines throughout before collapse

SLATES.

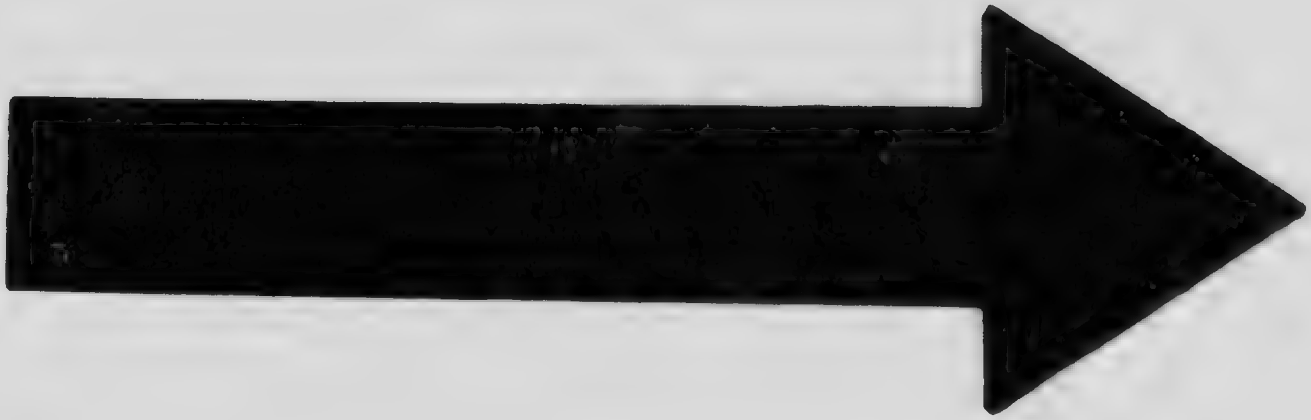
No.	Owner	Area	Formation	Crushing strength, lbs. per sq. in.	Remarks
762	New Rockland Slate Co.	Melbourne.	Cambrian.	34,000	Slight preliminary failure at bottom; lower wedges.
770	Danbrausean (Old Steele quarry).	Melbourne.	Cambrian.	30,580	Spread before the sudden collapse; lower wedges.
830	.	Actonvale.	Cambrian.	30,550	Cracked in middle before collapse; lower wedges.
840	Frazer and Davis.	Temiscouata	Cambrian.	..	Cubes parted on cleavage planes making the tests unreliable.

TABLE IV.

The Comparative Crushing Strength of Quebec Building Stones, dry, wet, and wet after being frozen forty times.

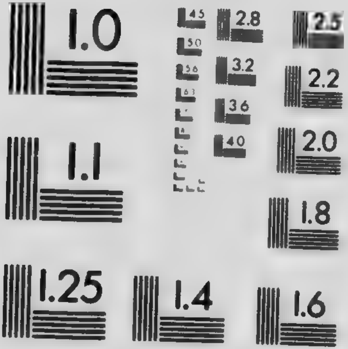
LIMESTONES

No.	OWNER	Area	Crushing strength, lbs. per sq. in. Dry	Wet	Wet after freezing	REMARKS
583	Rogers and Quirk	Montreal	24,350	19,330	12,880	The frozen result is probably low as the failure was caused from one side.
584	Morrison Quarry Co	Montreal	22,400	20,430	17,870	
588	Villeray Quarry Co	Montreal	21,610	20,500	18,260	
596	François Corbeil	Montreal, Côte St. Michel	19,520	19,540	16,780	
606	Montreal Prison	Montreal, Bordeaux	19,550	18,610	17,449	Wet cubes squeeze out on shaly partings.
598	Joseph Legaré	Montreal, [illegible]ville	20,800	18,800	18,060	
604	Damien Bigras	Montreal, Village St. Martin	22,350	21,400	20,220	
[illegible]5	Gregoire Dagenais	Montreal, Village Belanger	24,450	22,780	19,940	
590	Standard Quarry Co	Montreal, St. Vincent de Paul	22,350	21,200	20,650	
594	Felix Labelle	Montreal, St. François-de-Salles	20,450	20,850	19,680	The dry test is probably a little low as the cube cracked at one corner.
575	Georges Chateauvert	St. Marc des Carrières	17,980	17,220	14,250	The frozen result is probably low as the cube yielded at one side first.
599	Edouard Lauzon	Joliette	16,030	14,130	13,850	
601	Edouard Lauzon	Joliette	1[illegible],350	13,610	11,540	The wet test is evidently low, no apparent reason.
629	Wright and Co	Hull	20,580	17,060	17,730	The wet result is slightly low as the cube [illegible] on one side first.
633	David Laviolette	Hull	25,100	22,150	19,600	
700	Narcisse Lord	St. Johns	31,162	30,810	29,430	
709	Alex. St. George	St. Johns, Grande Ligne	20,860	13,9[illegible]	13,350	Wet test is probably a little low as cube yielded on one side.
706	Otis.	St. Johns, Grande Ligne	19,180	16,160	16,000	Both wet cubes gave upper cone, dry cubes, lower pyramid.
574	Quebec Brick Co	Beauport	44,400	35,080	31,080	
759	William Bentley	Dudswell	29,200	33,500		Variable results are always obtained with stones of this type owing to the different development of shaly partings.
825		Millstream	20,280	13,210	10,220	The stone in each case contained incipient flaws whereby the contrast is increased.
831	Pierre Dumas	St. Dominique	26,150	25,900	21,800	



MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



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SANDSTONES

No.	OWNER	Area	Crushing strength, lbs. per sq. in.			REMARKS
			Dry	Wet	Wet after freezing	
571	J. T. Dussault.........	Quebec-Levis	27,000	18,120	16,800	
609	Euclide Mompetit ..	Beauharnois	....	39,600	30,800	
822	T. R. Busteed....	Bourdeau	14,970	8,640	8,140	
826	A. Lajoie........	Causapscal	31,200	18,750	22,800	

GRANITES

No.	OWNER	Area	Crushing strength, lbs. per sq. in.			REMARKS
			Dry	Wet	Wet after freezing	
743	James Brodie..........	Stanstead	24,900	22,450	22,450	
744	Samuel Norton....	Stanstead	23,770	21,100	21,850	Wet cube failed from one side just before collapse.
749	G. W. Moir.....	Stanstead	27,080	21,800	22,100	
751	Frontier Granite Co...	Stanhope	28,500	25,900	25,500	
788	Lacombe and D'Allaire	St. Sebastien	36,820	33,700	34,900	
617	Joseph Cyr............	St. Jerome, St. Canut	39,000	39,000	29,360	Frozen cube failed under sustained load; result low.
839	James Brodie..........	Ottawa	33,100	34,800	31,320	Dry cube failed from one side; result probably a little low.
619	Laurentian Granite Co.	Argenteuil	37,590	36,300	38,100	The stone is practically unaffected by water and frost.
576	Joseph Perron	Rivière à Pierre	24,730	22,400	20,430	
578	Fortunat Veyer.....	Rivière à Pierre	29,600	29,600	26,210	Frozen test is probably a little low.
579	August Bernier..	Roberval	30,650	28,550	28,600	
580	August Bernier..	Roberval	28,150	23,100	22,290	

BLACK GRANITES, ETC.

No.	OWNER	Area	Crushing strength, lbs. per sq. in. Dry	Wet	Wet after freezing	REMARKS
581	Morrison Quarry Co....	Montreal	45,700	44.700		Both cubes showed original incipient cracks.
702	Mount Johnson Quarry.. Co....	Mount Johnson	40,900		39.630	
703	Mount Johnson Quarry Co.. ..	Mount Johnson	36,500		36.000	These stones are not measureably affected by water and frost.
704	Mount Johnson Quarry Co ..	Mount Johnson	41.300		42.100	
837	Can. Pac. Railway ...	Yamaska Mount'n	29.420	25.080	23.950	All samples spit out at sides before collapse.
776	Danville Granite and Asbestos Co .	Danville	34.400	29.410		

MARBLES

No.	OWNER	Area	Crushing strength, lbs. per sq. in. Dry	Wet	Wet after freezing	REMARKS
642	Pontiac Marble and Lime Co... ...	Portage du Fort	21.850	21.850	22 210	
644	.	Portage du Fort	21.200	20.800	16.800	
713	Missisquoi Lautz Corp	Missisquoi	20.380	19.560	18.250	
714	Missisquoi-Lautz Corp .	Missisquoi	20.360	16.350?	16.560	
736	Dominion Marble Co..	S. Stukely	17.450	16.520	15.580	

SLATES

No.	OWNER	Area	Crushing strength, lbs. per sq. in.			REMARKS
			Dry	Wet	Wet after freezing	
762	New Rockland Slate Co	Melbourne	34,090	32,350	28,080	
770	Steele Quarry	Melbourne	30,580	10,000		The wet cube had parted on cleavage planes in the water.
830	...	Actonvale	30,550			
840	Frazer and Davis	Temiscouata	....			The cubes all parted on cleavage planes making the determinations impossible.

TABLE V.

The Transverse Strength of Quebec Building Stones.

LIMESTONES.

No.	Owner	Area	Transverse Strength Modulus of Rupture, lbs per sq. in.	Remarks
583	Rogers and Quirk	Montreal	3,[illegible]95	Hackly fracture slightly off central line and diagonal.
584	Morrison Quarry Co. .	Montreal	[illegible]	Straight fracture, hackly, ¼ in. off line at one side and ¼ in. off line at the other.
588	Villeray Quarry Co	Montreal	2,637	Rather irregular fracture crossing line diagonally at low angle.
596	Francois Corbeil	Montreal, Côte St. Michel	2,670	Hackly fracture, on line at one side and ¼ in. off on the other.
606	Montreal Prison	Montreal, Bordeaux	2,792	Hackly fracture but almost on line; straight.
598	Joseph Legacé	Montreal, Cartierville	2,830	Irregular fracture, near line but slightly inclined.
604	Damien Bigras. . . .	Montreal, Village St. Martin	3,083	Straight fracture, slightly hackly, on line at one side and ¼ in. off on the other.
605	Gregoire Dagenais	Montreal, Village Belanger. .	2,948	Slightly irregular fracture, almost on line
590	Standard Quarry Co .	Montreal, St. Vincent de Paul. .	3,495	Smooth even fracture, on [illegible]
594	Felix Labelle	Montreal, St. Francois de Salles. .	3,010	Smooth even break almost on line.
575	Georges Chateauvert	St. Marc des Carrières	2,685	Slightly irregular and hackly, on line.
599	Edouard Lauzon .	Joliette. .	2,187	Hackly and irregular fracture, on line on one side and ⅝ in. off on the other.
601	Edouard Lauzon. . . .	Joliette. .	2,320	Hackly fracture but straight and on line.
629	Wright & Co.	Hull	2,588	Smooth fracture, ¼ in off on one side and ⅜ in. off on the other; inclined.
633	David Laviolette	Hull	3,273	Smooth and even on line.
700	Narcisse Lord.	St. Johns	4,550	Fine even fracture, ⅛ in. off line on one side and ⅜ off on the other, inclined.
706	Otis.	St. Johns-Grande Ligne	2,210	Slightly irregular fracture, on line at one side, ⅜ off on the other.
709	Alexander St. George .	St. Johns-Grande Ligne	2,710	Hackly but almost straight near the line.
574	Quebec Brick Co .	Beauport.	3,520	Broke with a curved fracture 1½ in. from line, probably on a flaw; the result is probably low.
825	. . . . .	Millstream. .	4,684	Extremely uneven fracture, angular and splintery.
831	Pierre Dumas. . .	St. Dominique. .	3,405	Irregular fracture, ⅛ in. off line on one side and ¼ in. off line on the other, inclined.

SANDSTONES.

No.	Owner	Area	Transverse Strength; Modulus of Rupture, lbs. per sq. in.	Remarks.
571	J. I Dussault	Quebec-Levis	2,740	Hackly fracture almost on line.
822	T. R. Busteed	Bourdeau....	1,745	Slightly uneven but straight and almost on line.
826	A. Lajoie ...	Causapscal...	913	Fairly even and straight, on line.

GRANITES.

No.	Owner	Area	Transverse Strength; Modulus of Rupture, lbs. per sq. in.	Remarks.
743	James Brodie	Stanstead....	1,734	Slightly irregular, almost on line.
744	Samuel Norton......	Stanstead...	2,192	Slightly irregular but almost on the central line.
749	G. W. Moir .	Stanstead....	1,360	Rather irregular, ¼ in. from line.
751	Frontier Granite Co. .	Stanhope....	2,133	Rather irregular, on line at one side and ¼ in. off on the other.
788	Lacombe and D'Allaire....	Megantic, St.Sebastien .	4,935	Even, exactly on line.
839	James Brodie	Ottawa......	2,810	Fine and smooth; concavo-convex close to line.
619	Laurentian Granite Co. .	Argenteuil...	2,810	Irregular fracture, on line at one side, ¼ in. off on the other.
576	Joseph Perron......	Rivière à Pierre.......	2,950	Even, on line at one side, ¼ in. off on the other.
578	Fortunat Voyer..	Rivière à Pierre.......	1,740	Irregular, crosses line diagonally at low angle.
579	August Bernier......	Roberval....	2,393	Irregalar, on line at one side, ½ in. off on the other.
580	August Bernier......	Roberval....	1,810	Hackly but straight 1¼ in. from line.

BLACK GRANITES, ETC.

No.	Owner	Area	Transverse Strength Modulus of Rupture, lbs per sq. in	Remarks
581	Morrison Quarry Co..	Montreal	468	Fracture concavo-convex almost on line; result unreliable as the specimen showed flaws.
702	Mount Johnson Quarry Co...	Mount Johnson..	3,265	Uneven fracture, on line at one side, ¼ in. off on the other.
703	Mount Johnson Quarry Co..	Mount Johnson	2,411	Slightly uneven, ¼ in. off line on one side, ¼ in. off on other
704	Mount Johnson Quarry Co..	Mount Johnson. ...	2,790	Slightly uneven fracture, almost on line.
837	Can. Pacific Railway.....	Yamaska Mountain..	1,745	Slightly uneven fracture, almost on line.
776	Danville Granite and Asbestos Co.	Danville.....	2,712	Slightly irregular but almost on line.

MARBLES.

No.	Owner	Area	Transverse Strength; Modulus of Rupture, lbs. per sq. in.	Remarks.
642	Pontiac Marble and Lime Co....	Portage du Fort........	1,238	Very hackly, slightly irregular, diagonally across line at low angle.
644	....	Portage du Fort........	2,325	Hackly, on line at one side, ¼ in. off line at the other.
713	Missisquoi-Lautz Corp. .	Missisquoi...	2,256	Smooth, even and almost on line but slighty inclined.
714	Missisquoi-Lautz Corp..	Missisquoi...	1,987	Slightly more irregular than 713.
736	Dominion Marble Co..	South Stukely.....	3,115	Snapped, even fracture, on line at one side, ¼ in. off on the other.

SLATES.

No	Owner	Area	Transverse Strength: Modulus of Rupture, lbs. per sq. in.	Remarks.
762	New Rockland Slate Co....	Melbourne, New Rockland ..	13,125	Straight serrated break on centre: no splitting.
830	....	Actonvale ..	4,245	Close to line, sharply serrated on cleavage planes.
		(duplicate)...	3,990	
840	Frazer and Davis....	Temiscouata.	3,610	On line, sharply serrated on the cleavage planes. Split on cleavage.
		(duplicate)...	2,900	
760	W. Berwick	Orford-Brompton...	5,060	Broke from one end support and split on bedding.
761	Valcourt	Orford-Brompton...	3,163	Broke across with serrated edges and splits along the bedding.

With the exception of the New Rockland slate all the above examples were either derived from old material or, in the case of the Temiscouata slate, taken from the surface. These results are undoubtedly much lower than fresh material would give.

TABLE XI.

The Shearing Strength of Quebec Building Stones.

LIMESTONES.

No.	Owner	Area	Shearing strength, lbs. per sq. in.	Remarks
583	Rogers and Quirk	Montreal	2,478	Sheared square across.
584	Morrison Quarry Co	Montreal	1,630	Sheared square across, broke in holder.
588	Villeray Quarry Co	Montreal	1,100	Sheared slightly under
596	Francois Corbeil.	Montreal, Côte St Michel	1,845	Sheared square across, corner chipped.
606	Montreal Prison	Montreal, Bordeaux	1,445	Corner shear
598	Joseph Legacé.	Montreal, Cartierville	2,145	Sheared square across
604	Damien Bigras	Montreal, Village St Martin	2,155	Corner shear
605	Gregoire Dagenais	Montreal, Village Belanger	1,225	Sheared square across
590	Standard Quarry Co.	Montreal, St. Vincent de Paul	1,940	Sheared square across, corner broke off.
594	Felix Labelle..	Montreal, St. Francois de Salles	1,470	Sheared square across.
575	Georges Chateauvert	St. Marc des Carrières.	1,750	Sheared square across.
599	Edouard Lauzon.	Joliette	1,000	Sheared square across.
601	Edouard Lauzon.	Joliette	1,130	Sheared square across.
629	Wright and Co..	Hull	1,895	Sheared square across.
633	David Lavielette	Hull	1,770	Sheared square across.
700	Narcisse Lord..	St. Johns	2,075	Chipped in holder.
706	Otis...	St. Johns - Grande Ligne	1,325	Sheared square across.
709	Alexander St. George	St. Johns - Grande Ligne	1,835	Sheared square across.
574	Quebec Brick Co.	Beauport.	3,380	Concave shear.
825	....	Millstream	4,555	Hard and brittle, broke into small pieces.
831	Pierre Dumas.. ...	St. Dominique	3,500	Sheared square across, chipped in holder.

SANDSTONES.

No.	Owner	Area	Shearing strength, lbs. per sq. in.	Remarks
571	J. T. Dussault........	Quebec-Levis.	2,174	Sheared square across.
822	T. R. Busteed.......	Bourdeau....	995	Sheared square across.
826	A. Lajoie............	Causapscal.........	1,740	Sheared square across.

GRANITES.

No.	Owner	Area	Shearing strength, lbs. per sq. in.	Remarks
743	James Brodie	Stanstead	1,475	Concave shear.
744	Samuel Norton	Stanstead	1,570	Sheared square across.
794	G. W. Moir	Stanstead	1,230	Sheared square across chipped in the holder
751	Frontier Granite Co	Stanhope	1,885	Sheared square across
788	Lacombe and D'Allaire	Megantic St. Sebastien	2,300	Sheared square across
839	James Brodie	Ottawa	2,355	Sheared square across
619	Laurentian Granite Co	Argenteuil	1,590	Sheared square across
576	Joseph Perron	Rivière à Pierre	2,225	Sheared square across
578	Fortunat Voyer	Rivière à Pierre	1,845	Sheared square across
579	August Bernier	Roberval	1,867	Sheared square across
580	August Bernier	Roberval	1,305	Sheared square across.

BLACK GRANITES, ETC

No.	Owner	Area	Shearing strength, lbs. per sq. in.	Remarks
581	Morrison Quarry Co	Montreal.	3,320	Concave shear.
702	Mount Johnson Quarry Co	Mount Johnson....	2,140	Edges crumbled, sheared slightly back in holder.
703	Mount Johnson Quarry Co			
704	Mount Johnson Quarry Co	Mount Johnson....	1,955	Sheared square across.
		Mount Johnson ..	2,382	Sheared square across.
837	Can. Pacific Railway	Yamaska Mountain	1,890	Sheared square across.
776	Danville Granite and Asbestos Co	Danville....	2,380	Sheared square across, chipped slightly in holder

MARBLES.

No.	Owner	Area	Shearing strength, lbs. per sq. in.	Remarks
642	Pontiac Marble and Lime Co...	Portage du Fort.	1,200	Crumbled at the edge of shearing plane.
644	....	Portage du Fort.	1,490	Sheared square across.
713	Missisquoi-Lautz Corp	Missisquoi .. .	1,135	Sheared square across.
714	Missisquoi-Lautz Corp.	Missisquoi .	1,205	Sheared square across.
736	Dominion Marble Co.	South Stukely	1,665	Sheared slightly under.

SLATES

No.	Owner	Area	[illegible]	[illegible]
840	New Rockland Slate Manufacturing Co.	[illegible]	[illegible]	[illegible]
840	[illegible] and [illegible]	[illegible]	[illegible]	[illegible]

TABLE VII.

The Chiselling and the Drilling Factors of Quebec Building Stones.*

LIMESTONES.

No.	OWNER	Area	Drilling Factor, mm. per 30 sec.	Chiselling Factor, grams per three inches per ten seconds Factor	 Remarks
583	Rogers and Quirk	Montreal	9.7	3.5	Uneven track rather on one side, small splinters, result probably low
584	Morrison Quarry Co	Montreal	14.3	5.4	Smooth and even track.
588	Villeray Quarry Co	Montreal	18.00	5.9	Rough track, small splinters
596	Francois Corbeil	Montreal	8.8	8.0	Chisel jumps ! and dug in deeply, result too high
			9.3		
606	Montreal Prison	Montreal	9.8	4.4	Fairly even track, fine splinters
598	Joseph Legacé	Montreal	9.5		Chisel dug in and split slab on bedding
604	Damien Bigras	Montreal	10.7	6.0	Even track; small splinters
605	Gregoire Dagenais	Montreal	9.5	7.2	Slightly rough track, fine splinters
590	Standard Quarry Co.	Montreal	9.0	8.2	Rough track medium splinters
594	Felix Labelle	Montreal	7.9	5.6	Fine even track, no splinters
575	Georges Chateauvert	St. Marc des Carrières	12.9	6.2	Fairly even track, small splinters
599	Edouard Lauzon.	Joliette	12.4	7.8	Rough track; fine splinters
601	Edouard Lauzon.	Joliette	16.7	10.0	Slightly uneven track, small splinters
629	Wright and Co.	Hull	11.9	7.2	Good even track; few splinters
633	David Laviolette.	Hull	13.2	9.6	Uneven and splintery track
700	Narcisse Lord	St. Johns	4.8	5.7	Fairly even track; flaky splinters
706	Otis	St. Johns-Grande Ligne	9.4		
709	Alexander St. George	St. Johns-Grande Ligne	9.3	5.6	Even track; very small splinters
574	Quebec Brick Co.	Beauport	6.6	5.3	Rough track; many flaky splinters
825		Millstream	7.8	2.0	Even track; no splinters.
831	Pierre Dumas.	St. Dominique	6.3	8.5	Very uneven track; many splinters

SANDSTONES

No.	OWNER	Area	Drilling Factor, mm. per 30 sec.	Chiseling Factor, grams per three inches per ten seconds Factor	Remarks
571	J. T. Dussault	Quebec Levis	16		
822	T. R. Busteed	Bourdeau	22.4	8	Rough track, no splinters
826	A. Lajoie	Causapscal	10.2	5.4	Smooth even track

GRANITES

No.	OWNER	Area	Drilling Factor, mm. per 30 sec.	Remarks
743	James Brodie	Stanstead	6.8	
744	Samuel Norton	Stanstead	6.7	
749	C. W. Moir	Stanstead	7.6	
751	Frontier Granite Co	Stanhope	4.0	
788	Lacombe and D'Allaire	Megantic	3.5	
839	James Brodie	Ottawa	2.8	
619	Laurentian Granite Co	Argenteuil	4.1	Result is high as it represents the [illegible] not having a flat bottom but being [illegible] wearing down of the outer angles of [illegible]
576	Joseph Perron	Rivière à Pierre	8.0	
578	Fortunat Voyer	Rivière à Pierre	4.4	
579	August Bernier	Roberval	5.3	
580	August Bernier	Roberval	5.7	
770	Danville Granite Co	Danville	1.9	

BLACK GRANITES, ETC.

No.	OWNER	Area	Drilling Factor mm. per 30 sec.	Remarks
581	Morrison Quarry Co...........	Montreal	4.0	Maximum in centre.
702	Mount Johnson Quarry Co	Mount Johnson	3.8	
703	Mount Johnson Quarry Co..	Mount Johnson	4.1	
704	Mount Johnson Quarry Co	Mount Johnson	4.1	
837	Can. Pac. Railway Co...........	Yamaska Mountain	2.2	

MARBLES

No.	OWNER	Area	Drilling Factor mm. per 30 sec.	Chiselling Factor, grams per three inches per ten seconds.	
				Factor	Remarks
624	Pontiac Marble and Lime Co......	Portage du Fort	15.3	6.0	Stone broke; result high.
644	....	Portage du Fort	9.0	8.1	Uneven and splintery track.
713	Missisquoi-Lautz Corp..	Missisquoi	11.4	5.4	Even track; small splinters.
714	Missisquoi-Lautz Corp	Missisquoi	10.6	5.6	Even track; small splinters.
736	Dominion Marble Co..............	South Stukely	13.4	6.8	Slightly uneven track; small splinters.

---

*This table is not to be interpreted too literally, but is to be considered with due regard to the remarks on page 17

TABLE VIII.

The Change in Weight per Square Inch of Surface exposed and the Colour Changes produced by soaking specimens of Quebec Building Stones in water saturated with Oxygen and Carbonic Acid for four weeks.

LIMESTONES

No.	Owner	Area	Change in Weight grams per sq. in. Loss	Change in Weight grams per sq. in. Gain	Colour Changes
583	Rogers and Quirk	Montreal	0.01732		The blue bands become light brownish grey marked with still lighter specks representing fossil fragments. The brownish bands are not much changed but appear darker by contrast.
584	Morrison Quarry Co.	Montreal	0.02712		Loses the bluish and crystalline appearance, assumes a light brownish tone in the base with the fossil fragments showing prominently as lighter specks. The general tone is darker and the fragments smaller than in No. 575.
588	Villeray Quarry Co.	Montreal	0.02582		Acts like No. 584 but it is slightly coarser and shows more dark specks which are calcite crystals.
596	Francois Corbeil	Montreal	0.0267		Acts like No. 584 but is of coarser grain. Like 575 but darker.
606	Montreal Prison	Montreal, Bordeaux	0.02374		Becomes greyish. Two elements are apparent, a dead dirty ground mass and crystalline fossils of darker colour.
598	Joseph Legacé	Montreal, Cartierville	0.02226		Loses blue cast and becomes grey but the change in shade is less marked than in other of these stones. The fossils are coarse. Fine dark brown lines appear.
604	Damien Bigras	Montreal Village St. Martin	0.01718		Loses blue, becomes grey, shows numerous dark specks of oolitic nature. Fine and uniform. Stone is darker and more finely speckled than most of these limestones.
605	Gregoire Dagenais	Montreal, Village Belanger	0.02098		Turns grey much like No. 604. shows numerous rounded calcite grains.
590	Standard Quarry Co.	Montreal, St. Vincent de Paul	0.0183		Loses blue and becomes grey, shows fine grain. The bands show as fine dark brownish lines.

LIMESTONES—*Continued.*

No.	Owner	Area	Change in Weight, grams per sq. in. Loss	Change in Weight, grams per sq. in. Gain	Colour Changes.
594	Felix Labelle	Montreal, St. Francois de Salles	0.02425		Turns grey, shows a fine grained partially oolitic structure in the base.
575	Georges Chateauvert	St. Marc des Carrières	0.0265		Loses blue. Assumes a brownish light colour in the base with the fossil fragments showing as still lighter specks uniformly distributed.
599	Edouard Lauzon	Joliette	0.0300		Acts like No. 575 but has a slightly darker general colour with much the same grain.
601	Edouard Lauzon.	Joliette	0.03184		Assumes almost exactly the colour of No. 575 but the fossil fragments are larger.
629	Wright & Co.	Hull	0.02785		Very similar to No. 596 in both grain and colour.
633	David Laviolette	Hull	0.03345		Turns grey but shows a very fine and even grain. It is superior in this respect to any of the Montreal stones.
700	Narcisse Lord.	St. Johns	0.02455		Turns a uniform grey colour in the blue parts, grey and speckled in the intercalated bands.
706	Otis	St. Johns-Grande Ligne	0.02410		Turns grey, shows whitish grey ground mass with the fossil fragments as dark crystalline specks.
709	Alexander St. George	St. Johns-Grande Ligne	0.02453		Greyish with oolitic ground mass. The fossil fragments appear as crystalline darker spots.
574	Quebec Brick Co.	Beauport	0.0154		Assumes a light brownish-grey dull colour with still lighter streaks.
759	William Bentley.	Dudswell	0.01909		The lines of stratification become more clearly marked.
825		Millstream		0.00326	This specimen shows a gain of 0.00326 which is probably due to the presence of clay.
831	Pierre Dumas	St. Dominique	0.013621		Becomes muddy brownish grey and dirty with stronger colour contrasts.

SANDSTONES.

No.	Owner	Area	Change in Weight, grams per sq. in. Loss	Change in Weight, grams per sq. in. Gain	Colour Changes
571	J. T. Dussault	Quebec-Levis		0.00143	Very little alteration.
609	Euclide Mompetit	Beauharnois	0.00084		No apparent change.
822	T. R. Busteed	Bourdeau	0.000178		Very little change.
826	A. Lajoie	Causapscal	1.000409		Becomes slightly darker.

GRANITES.

No.	Owner	Area	Change in Weight, grams per sq. in. Loss	Change in Weight, grams per sq. in. Gain	Colour Changes
743	James Brodie	Stanstead	0.000804		Scarcely any change. Feldspar is slightly duller in tone.
744	Samuel Norton	Stanstead	0.00128		Scarcely any change. Feldspar is slightly duller in tone.
749	G. W. Moir	Stanstead	0.000648		Scarcely any change. Feldspar is slightly duller in tone.
751	Frontier Granite Co.	Stanhope		0.000256	No apparent change.
788	Lacombe and D'Allaire	Megantic	0.000312		" " "
617	Joseph Cyr	St. Jerome		0.000296	" " "
839	James Brodie	Ottawa	0.000959		" " "
619	Laurentian Granite Co.	Argenteuil		0.000396	" " "
576	Joseph Perron	Rivière à Pierre	0.00352		" " "
578	Fortunat Voyer	Rivière à Pierre	0.00007		" " "
579	August Bernier	Roberval	0.00007		" " "
580	August Bernier	Roberval	0.00000		" " "

BLACK GRANITES, ETC.

No.	Owner	Area	Change in Weight, grams per sq. in.		Colour Changes.
			Loss	Gain	
581	Morrison Quarry Co...	Montreal.	0.000925		No apparent change.
702	Mount Johnson Quarry Co...	Mount Johnson		0.000369	No change. This gain is unexpected and requires verification.
703	Mount Johnson Quarry Co...	Mount Johnson.	0.00176		No apparent change.
704	Mount Johnson Quarry Co..	Mount Johnson.....	0.000409		" " "
837	Can. Pac. Railway.....	Yamaska Mountain .		0.000163	" " "
776	Danville Granite and Asbestos Co.	Danville .		0.000888	" " "

MARBLES.

No.	Owner	Area	Change in Weight, grams per sq. in.		Colour Changes.
			Loss	Gain	
642	Pontiac Marble and Lime Co.....	Portage du Fort........	0.001645		Becomes finely pitted, observable only with lens.
644	....	Portage du Fort........	0.02808		Etched all over and slightly whitened
713	Missisquoi-Lautz Corp..	Missisquoi...	0.03472		Whitened and deadened with increase of contrast.
714	Missisquoi-Lautz Corp..	Missisquoi...	0.03071		Whitened and deadened with increase of contrast.
736	Dominion Marble Co...	South Stukely..	0.01900		Loses yellow tone, becomes roughened and pitted. Pyrite grains show plainly.

SLATES.

No.	Owner	Area	Change in Weight, grams per sq. in.		Colour Changes.
			Loss	Gain	
762	New Rockland Slate Co.	Melbourne. .		0.00195	No apparent change.
770	Old Steele quarry	Melbourne...	0.000364		No apparent change.
830	....	Actonvale..		0.000466	Darkened slightly.
840	Frazer and Davis	Temiscouata	0.000466		

APPENDIX II.

Production of Stone in Quebec in 1911.

Compiled from the Report of the Mines Branch of the Department of Colonization, Mines and Fisheries of Quebec

	Number of Workmen	Salaries	Quantities	Value
Slate	25	$ 7,522		$ 8,248
Marble	170	105,739		143,457
Flagstone	2	500	Squares 6	500
Granite	423	239,704		308,545
Limestone	1,255	569,818		1,128,402

APPENDIX III.

Production of Stone in Quebec in 1912.

Compiled from the Report of the Mines Branch of the Department of Colonization, Mines and Fisheries of Quebec

	Number of Workmen	Salaries	Quantities	Value
Slate	25		Squares, 1894	$ 8,939
Marble	282	$141,832		252,041
Flagstone	4	550		600
Granite	637	268,762		358,749
Limestone	1,547	768,562		1,363,555

APPENDIX IV.

Production of Stone in Quebec in 1910 and 1911 and the Purpose for which it was used.

Compiled from the Report on the Mineral Production of Canada, 1911.

	Building	Ornamental and Monumental	Paving and Curbstone	Rubble	Crushed	Furnace Flux	Total
1910	$707,890	$116,456	$165,730	$143,930	$329,627	$6,053	$1,469,686
1911	599,758	242,269	151,242	200,243	700,787	593	1,894,892

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REPORTS

1. Mining conditions in the Klondike, Yukon. Report on—by Eugene Haanel, Ph.D., 1902.

†2. Great landslide at Frank, Alta. Report on—by R. G. McConnell, B.A., and R. W. Brock, M.A., 1903.

†3. Investigation of the different electro-thermic processes for the smelting of iron ores, and the making of steel, in operation in Europe. Report of Special Commission by Eugene Haanel, Ph.D., 1904.

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†7. Limestones, and the lime industry of Manitoba. Preliminary report on—by J. W. Wells, M.A., 1905.

†8. Clays and shales of Manitoba: their industrial value. Preliminary report on—by J. W. Wells, M.A., 1905.

†9. Hydraulic cements (raw materials) in Manitoba: manufacture and uses of. Preliminary report on—by J. W. Wells, M.A., 1905.

†10. Mica: its occurrence, exploitation, and uses—by Fritz Cirkel, M.E., 1905. (See No. 118.)

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†12. Zinc resources of British Columbia and the conditions affecting their exploitation. Report of the Commission appointed to investigate—by W. R. Ingalls, M.E., 1905.

†16. *Experiments made at Sault Ste. Marie, under Government auspices, in the smelting of Canadian iron ores by the electro-thermic process. Final report on—by Eugene Haanel, Ph.D., 1907.

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†19. Peat and lignite: their manufacture and uses in Europe—by Erik Nystrom, M.E., 1908.

†20. Iron ore deposits of Nova Scotia. Report on (Part I)—by J. E. Woodman, D.Sc.

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21. Summary report of Mines Branch, 1907-8.

22. Iron ore deposits of Thunder Bay and Rainy River districts. Report on—by F. Hille, M.E.

†23. Iron ore deposits along the Ottawa (Quebec side) and Gatineau rivers. Report on—by Fritz Cirkel, M.E.

24. General report on the mining and metallurgical industries of Canada, 1907-8.

25. The tungsten ores of Canada. Report on—by T. L. Walker, Ph.D.

26. The mineral production of Canada, 1906. Annual report on—by John McLeish B.A.

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29. Chrome iron ore deposits of the Eastern Townships. Monograph on—by Fritz Cirkel. (Supplementary section: Experiments with chromite at McGill University—by J. B. Porter, E.M., D.Sc.)

30. Investigation of the peat bogs and peat fuel industry of Canada, 1908. Bulletin No. 1—by Erik Nystrom, M.E., and A. Anrep, Peat Expert.

32. Investigation of electric shaft furnace, Sweden. Report on—by Eugene Haanel, Ph.D.

47. Iron ore deposits of Vancouver and Texada islands. Report on—by Einar Lindeman, M.E.

†55. Report on the bituminous, or oil-shales of New Brunswick and Nova Scotia; also on the oil-shale industry of Scotland—by R. W. Ells, LL.D.

58. The mineral production of Canada, 1907 and 1908. Annual report on—by John McLeish, B.A.

NOTE.—*The following parts were separately printed and issued in advance of the Annual Report for 1907-8.*

†31. Production of cement in Canada, 1908.

42. Production of iron and steel in Canada during the calendar years 1907 and 1908.

43. Production of chromite in Canada during the calendar years 1907 and 1908.

44. Production of asbestos in Canada during the calendar years 1907 and 1908.

†45. Production of coal, coke, and peat in Canada during the calendar years 1907 and 1908.

46. Production of natural gas and petroleum in Canada during the calendar years 1907 and 1908.

59. Chemical analyses of special economic importance made in the laboratories of the Department of Mines, 1906-7-8. Report on—by F. G. Wait, M.A., F.C.S. (With Appendix on the commercial methods and apparatus for the analysis of oil-shales—by H. A. Leverin, Ch. E.).
Schedule of charges for chemical analyses and assays.

†62. Mineral production of Canada, 1909. Preliminary report on—by John McLeish, B.A.

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67. Iron ore deposits of the Bristol mine, Pontiac county, Quebec. Bulletin No. 2—by Einar Lindeman, M.E., and Geo. C. Mackenzie, B.Sc.

†68. Recent advances in the construction of electric furnaces for the production of pig iron, steel, and zinc. Bulletin No. 3—by Eugene Haanel, Ph.D.

69. Chrysotile-asbestos: its occurrence, exploitation, milling, and uses. Report on—by Fritz Cirkel, M.E. (Second edition, enlarged.)

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†71. Investigation of the peat bogs, and peat industry of Canada, 1909-10; to which is appended Mr. Alf. Larson's paper on Dr. M. Ekenberg's wet-carbonizing process: from Teknisk Tidskrift, No. 12, December 26, 1908—translation by Mr. A. v. Anrep, Jr.; also a translation of Lieut. Ekelund's pamphlet entitled 'A solution of the peat problem,' 1909, describing the Ekelund process for the manufacture of peat powder, by Harold A. Leverin, Ch.E. Bulletin No. 4—by A. v. Anrep. (Second edition, enlarged.)

81. French translation: Chrysotile-asbestos, its occurrence, exploitation, milling, and uses. Report on—by Fritz Cirkel, M.E.

82. Magnetic concentration experiments. Bulletin No. 5—by Geo. C. Mackenzie, B.Sc.

83. An investigation of the coals of Canada with reference to their economic qualities as conducted at McGill University under the authority of the Dominion Government. Report on—by J. B. Porter, E.M., D.Sc., R. J. Durley, Ma.E., and others.

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    Producer tests and diagrams.

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  Appendix IV
    Coking tests.
  Appendix V
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†84. Gypsum deposits of the Maritime provinces of Canada—including the Magdalen islands. Report on—by W. F. Jennison, M.E. (See No. 245.)

88. The mineral production of Canada, 1909. Annual report on—by John McLeish, B.A.

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†79. Production of iron and steel in Canada during the calendar year 1909.

†80. Production of coal and coke in Canada during the calendar year 1909.

85. Production of cement, lime, clay products, stone, and other structural materials during the calendar year 1909.

89. Reprint of presidential address delivered before the American Peat Society at Ottawa, July 25, 1910. By Eugene Haanel, Ph.D.

90. Proceedings of conference on explosives.

92. Investigation of the explosives industry in the Dominion of Canada, 1910. Report on—by Capt. Arthur Desborough. (Second edition.)

93. Molybdenum ores of Canada. Report on—by Professor T. L. Walker, Ph.D.

100. The building and ornamental stones of Canada: Building and ornamental stones of Ontario. Report on—by Professor W. A. Parks, Ph.D.

100a. French translation: The building and ornamental stones of Canada. Report on—by W. A. Parks, Ph.D.

102. Mineral production of Canada, 1910. Preliminary report on—by John McLeish, B.A.

†103. Summary report of Mines Branch, 1910.

104 Catalogue of publications of Mines Branch, from 1902 to 1911; containing tables of contents and list of maps, etc.

105. Austin Brook iron-bearing district. Report on—by E. Lindeman, M.E.

†Publications marked thus † are out of print.

110. Western portion of Torbrook iron ore deposits, Annapolis county, N.S. Bulletin No. 7—by Howells Fréchette, M.Sc.

111. Diamond drilling at Point Mamainse, Ont. Bulletin No. 6—by A. C. Lane, Ph.D., with introductory by A. W. G. Wilson, Ph.D.

118. Mica: its occurrence, exploitation, and uses. Report on—by Hugh S. de Schmid, M.E.

142. Summary report of Mines Branch, 1911.

143. The mineral production of Canada, 1910. Annual report on—by John McLeish, B.A.

Note.—*The following parts were separately printed and issued in advance of the Annual Report for 1910.*

†114. Production of cement, lime, clay products, stone, and other structural materials in Canada, 1910.

†115. Production of iron and steel in Canada during the calendar year 1910.

†116. Production of coal and coke in Canada during the calendar year 1910.

†117. General summary of the mineral production of Canada during the calendar year 1910.

145. Magnetic iron sands of Natashkwan, Saguenay county, Que. Report on—by Geo. C. Mackenzie, B.Sc.

†150. The mineral production of Canada, 1911. Preliminary report on—by John McLeish, B.A.

151. Investigation of the peat bogs and peat industry of Canada, 1910–11. Bulletin No. 8—by A. v. Anrep.

154. The utilization of peat fuel for the production of power, being a record of experiments conducted at the Fuel Testing Station, Ottawa, 1910-11. Report on—by B. F. Haanel, B.Sc.

155. French translation: The utilization of peat fuel for the production of power, being a record of experiments conducted at the Fuel Testing Station, Ottawa, 1910-11. Report on—by B. F. Haanel, B.Sc.

156. French translation: The tungsten ores of Canada. Report on—by T. L. Walker, Ph.D.

167. Pyrites in Canada: its occurrence, exploitation, dressing, and uses. Report on—by A. W. G. Wilson, Ph.D.

170. The nickel industry: with special reference to the Sudbury region, Ont. Report on—by Professor A. P. Coleman, Ph.D.

184. Magnetite occurrences along the Central Ontario railway. Report on—by E. Lindeman, M.E.

196. French translation: Investigation of the peat bogs and peat industry of Canada, 1909-10; to which is appended Mr. Alf. Larson's paper on Dr. M. Ekenburg's wet-carbonizing process: from Teknisk Tidskrift, No. 12, December 26, 1908—translation by Mr. A. v. Anrep; also a translation of Lieut. Ekelund's pamphlet entitled "A solution of the peat problem," 1909, describing the Ekelund process for the manufacture of peat powder, by Harold A. Leverin, Ch. E. Bulletin No. 4—by A. v. Anrep. (Second Edition, enlarged.)

197. French translation: Molybdenum ores of Canada. Report on—by T. L. Walker, Ph.D.

198. French translation: Peat and lignite: their manufacture and uses in Europe. Report on—by Erik Nystrom, M.E., 1908.

201. The mineral production of Canada during the calendar year 1911. Annual report on—by John McLeish, B.A.

Note.—*The following parts were separately printed and issued in advance of the Annual Report for 1911.*

181. Production of cement, lime, clay products, stone, and other structural materials in Canada during the calendar year 1911. Bulletin on—by John McLeish, B.A.

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†Publications marked thus † are out of print.

- †182. Production of iron and steel in Canada during the calendar year 1911. Bulletin on—by John McLeish, B.A.
- 183. General summary of the mineral production in Canada during the calendar year 1911. Bulletin on—by John McLeish, B.A.
- †199. Production of copper, gold, lead, nickel, silver, zinc, and other metals of Canada, during the calendar year 1911. Bulletin on—by C. T. Cartwright, B.Sc.
- †200. The production of coal and coke in Canada during the calendar year 1911. Bulletin on—by John McLeish, B.A.

202. French translation: Graphite: its properties, occurrence, refining, and uses. Report on—by Fritz Cirkel, M.E., 1907.

203. Building stones of Canada—Vol. II: Building and ornamental stones of the Maritime Provinces. Report on—by W. A. Parks, Ph.D.

209. The copper smelting industry of Canada. Report on—by A. W. G. Wilson, Ph.D.

216. Mineral production of Canada, 1912. Preliminary report on—by John McLeish, B.A.

219. French translation: Austin Brook iron-bearing district. By E. Lindeman, M.E.

222. Lode mining in Yukon: an investigation of the quartz deposits of the Klondike division. Report on—by T. A. MacLean, B.Sc.

224. Summary report of the Mines Branch, 1912.

226. French translation: Chrome iron ore deposits of the Eastern Townships. Monograph on—by Fritz Cirkel, M.E. (Supplementary section: Experiments with chromite at McGill University—by J. B. Porter, E.M., D.Sc.

227. Sections of the Sydney coal fields—by J. G. S. Hudson, M.E.

†229. Summary report of the petroleum and natural gas resources of Canada, 1912—by F. G. Clapp, A.M. (See No. 224.)

230. Economic minerals and the mining industry of Canada.

231. French translation: Economic minerals and the mining industry of Canada.

233. French translation: Gypsum deposits of the Maritime Provinces of Canada—including the Magdalen islands. Report on—by W. F. Jennison, M.E.

259. Preparation of metallic cobalt by reduction of the oxide. Report on—by H. T. Kalmus, B.Sc., Ph.D.

262. The mineral production of Canada during the calendar year 1912. Annual report on—by John McLeish, B.A.

Note.—*The following parts were separately issued in advance of the Annual Report for 1912.*

- 238. General summary of the mineral production of Canada, during the calendar year 1912. Bulletin on—by John McLeish, B.A.
- †247. Production of iron and steel in Canada during the calendar year 1912. Bulletin on—by John McLeish, B.A.
- †256. Production of copper, gold, lead, nickel, silver, zinc, and other metals of Canada, during the calendar year 1912—by C. T. Cartwright, B.Sc.
- 257. Production of cement, lime, clay products, stone, and other structural materials during the calendar year 1912. Report on—by John McLeish, B.A.
- †258. Production of coal and coke in Canada, during the calendar year 1912. Bulletin on—by John McLeish, B.A.

279. Building and ornamental stones of Canada—Vol. III: Building and ornamental stones of Quebec. Report on—by W. A. Parks, Ph.D.

283. Mineral production of Canada, 1913. Preliminary report on—by John McLeish, B.A.

303. Moose Mountain iron ing district. Report on—by E. Lindeman, M.E.

The Division of Mineral Resources and Statistics has prepared the following lists of mine, smelter, and quarry operators, copies of which may be obtained on application:

Metal mines and smelters.
Coal mines.
Stone quarry operators
Manufacturers of clay products
Manufacturers of lime

Publications marked thus † are out of print.

IN THE PRESS

56. French translation: Bituminous or oil-shales of New Brunswick and Nova Scotia; also on the oil-shale industry of Scotland. Report on —by R. W. Ells, LL.D.

149. French translation: Magnetic iron sands of Natashkwan, Saguenay county, Que. Report on —by Geo. C. Mackenzie, B.Sc.

169. French translation: Pyrites in Canada: its occurrence, exploitation, dressing, and uses. Report on —by A. W. G. Wilson, Ph.D.

179. French translation: The nickel industry: with special reference to the Sudbury region, Ont. Report on —by Professor A. P. Coleman, Ph.D.

180. French translation: Investigation of the peat bogs, and peat industry of Canada, 1910-11. Bulletin No. 8 —by A. v. Anrep.

195. French translation: Magnetite occurrences along the Central Ontario railway. Report on —by E. Lindeman, M.E.

245. Gypsum in Canada: its occurrence, exploitation, and technology. Report on —by L. H. Cole, B.Sc.

254. Calabogie iron-bearing district. Report on —by E. Lindeman, M.E.

263. French translation: Recent advances in the construction of electric furnaces for the production of pig iron, steel, and zinc. Bulletin No. 3 —by Eugene Haanel, Ph.D.

264. French translation: Mica: its occurrence, exploitation, and uses. Report on —by Hugh S. de Schmid, M.E.

265. French translation: Annual mineral production of Canada, 1911. Report on —by John McLeish, B.A.

266. Investigation of the peat bogs and peat industry of Canada, 1911 and 1912. Bulletin No. 9 —by A. v. Anrep.

281. Report on bituminous sands of Northern Alberta —by S. C. Ells, M.E.

287. French translation: Production of iron and steel in Canada during the calendar year 1912. Bulletin on —by John McLeish, B.A.

288. French translation: Production of coal in Canada, during the calendar year —

288. French translation: Production of coal and coke in Canada, during the calendar year 1912. Bulletin on —by John McLeish, B.A.

289. French translation: Production of cement, lime, clay products, stone, and other structural materials during the calendar year 1912. Bulletin on —by John McLeish, B.A.

290. French translation: Production of copper, gold, lead, nickel, silver, zinc, and other metals of Canada, during the calendar year 1912. Bulletin on —by C. T. Cartwright, B.Sc.

291. On the petroleum and natural gas resources of Canada. Report on —by F. G. Clapp, A.M., and others.

299. Peat, lignite, and coal: their value as fuels for the production of gas and power in the by-product recovery producer. Report on —by B. F. Haanel, B.Sc.

305. Report on the non-metallic minerals used in the Canadian Manufacturing Industries. By H. Fréchette, M.Sc.

308. French translation: An investigation of the coals of Canada with reference to their economic qualities: as conducted at McGill University under the authority of the Dominion Government. Report on —by J. B. Porter, E.M., D.Sc., R. J. Durley, Ma.E., and others.

Vol. I Coal washing and coking tests.
Vol. II Boiler and gas producer tests.
Vol. III
  Appendix I
    Coal washing tests and diagrams.
Vol. IV
  Appendix II
    Boiler tests and diagrams.

309. The physical properties of cobalt. Part II. Report on —by H. T. Kalmus, B.Sc., Ph.D.

314 French translation [illegible] Report on—by [illegible], M.E.

315 The production of iron and steel [illegible] 191[illegible] by John McLeish, B.A.

316 The production of coal and coke [illegible] by John McLeish, B.A.

317 The production of copper, gold, [illegible] the calendar year 1913. Bulletin on—by [illegible]

318 The production of cement, lime [illegible] during the calendar year 1913. By J. McLeish, B.A.

319 General summary of the mineral production of [illegible] 1913. By J. McLeish, B.A.

320 Annual report of the mineral production of Canada during the calendar year 191[illegible] By J. McLeish, B.A.

MAPS

†6 Magnetometric survey, vertical intensity: Calabogie mine, Bagot township, Renfrew county, Ontario—by E. Nystrom, 1904. Scale 60 feet = 1 inch. Summary report, 1905. (See Map No. 249.)

†13 Magnetometric survey of the Belmont iron mines, Belmont township, Peterborough county, Ontario—by B. F. Haanel, 1905. Scale 60 feet = 1 inch. Summary report, 1905. (See Map No. 186.)

†14 Magnetometric survey of the Wilbur mine, Lavant township, Lanark county, Ontario—by B. F. Haanel, 1905. Scale 60 feet = 1 inch. Summary report, 1905.

†33 Magnetometric survey, vertical intensity: lot 1, concession VI, Mayo township, Hastings county, Ontario—by Howells Fréchette, 1909. Scale 60 feet = 1 inch.

†34 Magnetometric survey, vertical intensity: lots 2 and 3, concession VI, Mayo township, Hastings county, Ontario—by Howells Fréchette, 1909. Scale 60 feet = 1 inch.

†35 Magnetometric survey, vertical intensity: lots 10, 11, and 12, concession IX, and lots 11 and 12, concession VIII, Mayo township, Hastings county, Ontario—by Howells Fréchette, 1909. Scale 60 feet = 1 inch.

*36 Survey of Mer Bleue peat bog, Gloucester township, Carleton county, and Cumberland township, Russell county, Ontario—by Erik Nystrom, and A. v. Anrep. (Accompanying report No. 30.)

*37 Survey of Alfred peat bog, Alfred and Caledonia townships, Prescott county, Ontario—by Erik Nystrom and A. v. Anrep. (Accompanying report No. 30.)

*38 Survey of Welland peat bog, Wainfleet and Humberstone townships, Welland county, Ontario—by Erik Nystrom and A. v. Anrep. (Accompanying report No. 30.)

*39 Survey of Newington peat bog, Osnabruck, Roxborough, and Cornwall townships, Stormont county, Ontario—by Erik Nystrom and A. v. Anrep. (Accompanying report No. 30.)

*40 Survey of Perth peat bog, Drummond township, Lanark county, Ontario—by Erik Nystrom and A. v. Anrep. (Accompanying report No. 30.)

*41. Survey of Victoria Road peat bog, Bexley and Carden townships, Victoria county, Ontario—by Erik Nystrom and A. v. Anrep. (Accompanying report No. 30.)

*48 Magnetometric survey of Iron Crown claim at [illegible] river, Vancouver island, B.C.—by E. Lindeman. Scale 60 feet = 1 inch. (Accompanying report No. 47.)

*49 Magnetometric survey of Western Steel Iron claim, at Sechart, Vancouver island, B.C.—by E. Lindeman. Scale 60 feet = 1 inch. (Accompanying report No. 47.)

*53 Iron ore occurrences, Ottawa and Pontiac counties, Quebec, 1908—by J. White and Fritz Cirkel. (Accompanying report No. 23.)

Note.—1. Maps marked thus * are to be found only in reports.
2. Maps marked thus † have been printed independently of reports, hence can be procured separately by applicants.

*54. Iron ore occurrences, Argenteuil county, Quebec, 1908—by Fritz Cirkel. (Accompanying report No. 23). (Out of print

†57. The productive chrome iron ore district of Quebec—by Fritz Cirkel. (Accompanying report No. 29.)

†60. Magnetometric survey of the Bristol mine, Pontiac county, Quebec—by E. Lindeman. Scale 200 feet = 1 inch. (Accompanying report No. 67.)

†61. Topographical map of Bristol mine, Pontiac county, Quebec—by E. Lindeman Scale 200 feet = 1 inch. (Accompanying report No. 67.)

†64. Index map of Nova Scotia: Gypsum—by W. F. Jennison.

†65. Index map of New Brunswick: Gypsum—by W. F. Jennison

†66. Map of Magdalen islands: Gypsum—by W. F. Jennison.

Accompanyin report No. 84

†70. Magnetometric survey of Northeast Arm iron range, Lake Timagami, Nipissing district, Ontario—by E. Lindeman. Scale 200 feet = 1 inch. (Accompanyin report No 63.

†72. Brunner peat bog, Ontario—by A. v. Anrep

†73. Komoka peat bog, Ontario—by A. v. Anrep

†74. Brockville peat bog, Ontario—by A. v. Anrep

†75. Rondeau peat bog, Ontario—by A. v. Anrep

†76. Alfred peat bog, Ontario—by A. v. Anrep

†77. Alfred peat bog, Ontario: main ditch profile—by A. v. Anrep.

Out of print

†78. Map of asbestos region, Province of Quebec, 1910—by Fritz Cirkel. Scale 1 mile 1 inch. (Accompanying report No. 69.)

†94. Map showing Cobalt, Gowganda, Shiningtree, and Porcupine districts—by L. H Cole, B.Sc. (Accompanying Summary report, 1910.)

†95. General map of Canada, showing coal fields. (Accompanying report No. 83 by Dr. J. B. Porter.)

†96. General map of coal fields of Nova Scotia and New Brunswick. (Accompanying Report No. 83—by Dr. J. B. Porter.)

†97. General map showing coal fields in Alberta, Saskatchewan, and Manitoba. (Accompanying report No. 83—by Dr. J. B. Porter.)

†98. General map of coal fields in British Columbia. (Accompanying report No. 83 by Dr. J. B. Porter.)

†99. General map of coal field in Yukon Territory. (Accompanying report No. 83 by Dr. J. B. Porter.)

†106. Geological map of Austin Brook iron bearing district, Bathurst township, Gloucester county, N.B.—by E. Lindeman. Scale 400 feet = 1 inch. (Accompanying report No. 105.)

†107. Magnetometric survey, vertical intensity: Austin Brook iron bearing district—by E. Lindeman. Scale 400 feet = 1 inch. (Accompanying report No. 105.)

†108. Index map showing iron bearing area at Austin Brook—by E. Lindeman. (Accompanying report No. 105.)

*112. Sketch plan showing geology of Point Mamainse, Ont.—by Professor A. C. Lane Scale 4,000 feet = 1 inch. (Accompanying report No. 111.)

†113. Holland peat bog, Ontario—by A. v. Anrep. (Accompanying report No. 151.)

*119-137. Mica: township maps, Ontario and Quebec—by Hugh S. de Schmid. (Accompanying report No. 118.)

†138. Mica: showing location of principal mines and occurrences in the Quebec mica area—by Hugh S. de Schmid. Scale 3·95 miles = 1 inch. (Accompanying report No. 118.)

†139. Mica: showing location of principal mines and occurrences in the Ontario mica area—by Hugh S. de Schmid. Scale 3·95 miles = 1 inch. (Accompanying report No. 118.)

NOTE.—1. Maps marked thus * are to be found only in reports.
2. Maps marked thus † have been printed independently of reports, hence can be procured separately by applicants.

†140. Mica: showing distribution of the principal mica occurrences in the Dominion of Canada. By Hugh S. de Schmid. Scale 3.95 miles = 1 inch. Accompanying report No. 118.

†141. Torbrook iron bearing district, Annapolis county, N.S. By Howells Fréchette. Scale 400 feet = 1 inch. Accompanying report No. 110.

†146. Distribution of iron ore sands of the iron ore deposits on the north shore of the River and Gulf of St. Lawrence, Canada. By Geo. C. Mackenzie. Scale 100 miles = 1 inch. (Accompanying report No. 145.

†147. Magnetic iron sand deposits in relation to Natashkwan harbour and Great Natashkwan river, Que. (Index Map.) By Geo. C. Mackenzie. Scale 40 chains = 1 inch. Accompanying report No. 145.

†148. Natashkwan magnetic iron sand deposits, Saguenay county, Que. By Geo. C. Mackenzie. Scale 1,000 feet = 1 inch. Accompanying report No. 145.

†152. Map showing the location of peat bogs as yet investigated in Ontario. By A. v. Anrep.

†153. Map showing the location of peat bogs investigated in Manitoba. By A. v. Anrep.

†157. Lac du Bonnet peat bog, Manitoba. By A. v. Anrep.

†158. Transmission peat bog, Manitoba. By A. v. Anrep.

†159. Corduroy peat bog, Manitoba. By A. v. Anrep.

†160. Boggy Creek peat bog, Manitoba. By A. v. Anrep.

161. Rice Lake peat bog, Manitoba. By A. v. Anrep.

†162. Mud Lake peat bog, Manitoba. By A. v. Anrep.

†163. Litter peat bog, Manitoba. By A. v. Anrep.

Accompanying report No. 151.

†164. Julius peat litter bog, Manitoba. By A. v. Anrep.

†165. Fort Francis peat bog, Ontario. By A. v. Anrep.

Accompanying report No. 151.

*166. Magnetometric map of No. 3 mine, lot 7, concessions V and VI, McKim township, Sudbury district, Ont. By E. Lindeman. Accompanying Summary report, 1911.

†168. Map showing pyrites mines and prospects in Eastern Canada, and their relation to the United States market. By A. W. G. Wilson. Scale [illegible] inch. Accompanying report No. 167.

†171. Geological map of Sudbury nickel region, Ont. By Prof. A. P. Coleman. Scale 1 mile = 1 inch. (Accompanying report No. 170.)

172. Geological map of Victoria mine. By Prof. A. P. Coleman.

†173. " Crean Hill mine. By Prof. A. P. Coleman.

†174. " Creighton mine. By Prof. A. P. Coleman.

Accompanying report No. 170.

†175. " showing contact of norite and Laurentian in vicinity of Creighton mine. By Prof. A. P. Coleman. Accompanying report No. 170.

†176. " Copper Cliff offset. By Prof. A. P. Coleman. Accompanying report No. 170.

†177. " No. 3 mine. By Prof. A. P. Coleman. Accompanying report No. 170.

†178. " showing vicinity of Stobie and No. 3 mines. By Prof. A. P. Coleman. Accompanying report No. 170.

†185. Magnetometric survey, vertical intensity: Blairton iron mine, Belmont township, Peterborough county, Ontario. By E. Lindeman, 1911. Scale 200 feet = 1 inch. Accompanying report No. 184.

†185a. Geological map, Blairton iron mine, Belmont township, Peterborough county, Ontario. By E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

Note.—1. Maps marked thus * are to be found only in reports.
2. Maps marked thus † have been printed independently of reports, hence can be procured separately by applicants.

†186. Magnetometric survey, Belmont iron mine, Belmont township, Peterborough county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†186a. Geological map, Belmont iron mine, Belmont township, Peterborough county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†187. Magnetometric survey, vertical intensity: St. Charles mine, Tudor township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†187a. Geological map, St. Charles mine, Tudor township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†188. Magnetometric survey, vertical intensity: Baker mine, Tudor township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†188a. Geological map, Baker mine, Tudor township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†189. Magnetometric survey, vertical intensity: Ridge iron ore deposits, Wollaston township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†190. Magnetometric survey, vertical intensity: Cochill and Jenkins mines, Wollaston township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†190a. Geological map Cochill and Jenkins mines, Wollaston township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†191. Magnetometric survey, vertical intensity: Bessemer iron ore deposits, Mayo township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†191a. Geological map, Bessemer iron ore deposits, Mayo township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†192. Magnetometric survey, vertical intensity: Rankin, Childs, and Stevens mines, Mayo township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†192a. Geological map, Rankin, Childs, and Stevens mines, Mayo township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†193. Magnetometric survey, vertical intensity: Kennedy property, Carlow township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†193a. Geological map, Kennedy property, Carlow township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†194. Magnetometric survey, vertical intensity: Bow Lake iron ore occurrences, Faraday township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 184.)

†204. Index map, magnetite occurrences along the Central Ontario railway—by E. Lindeman, 1911. (Accompanying report No. 184.)

†205. Magnetometric map, Moose Mountain iron-bearing district, Sudbury district, Ontario: Deposits Nos. 1, 2, 3, 4, 5, 6, and 7—by E. Lindeman, 1912. (Accompanying report No. 303.)

†205a. Geological map, Moose Mountain iron-bearing district, Sudbury district, Ontario, Deposits Nos. 1, 2, 3, 4, 5, 6, and 7—by E. Lindeman. (Accompanying report No. 303.)

†206. Magnetometric survey of Moose Mountain iron-bearing district, Sudbury district, Ontario: northern part of deposit No. 2—by E. Lindeman, 1912. Scale 200 feet = 1 inch. (Accompanying report No. 303.)

NOTE.—1. Maps marked thus * are to be found only in reports.
2. Maps marked thus † have been printed independently of reports, hence can be procured separately by applicants.

†207. Magnetometric survey of Moose Mountain iron-bearing district, Sudbury district, Ontario: Deposits Nos. 8, 9, and 9A—by E. Lindeman, 1912. Scale 200 feet = 1 inch. (Accompanying report No. 303.)

†208. Magnetometric survey of Moose Mountain iron-bearing district, Sudbury district, Ontario: Deposit No. 10—by E. Lindeman, 1912. Scale 200 feet = 1 inch. (Accompanying report No. 303.)

†208a. Magnetometric survey, Moose Mountain iron-bearing district, Sudbury district, Ontario: eastern portion of Deposit No. 11—by E. Lindeman, 1912. Scale 200 feet = 1 inch. (Accompanying report No. 303.)

†208b. Magnetometric survey, Moose Mountain iron-bearing district, Sudbury district, Ontario: western portion of deposit No. 11—by E. Lindeman, 1912. Scale 200 feet = 1 inch. (Accompanying report No. 303.)

†208c. General geological map, Moose Mountain iron-bearing district, Sudbury district, Ontario—by E. Lindeman, 1912. Scale 800 feet = 1 inch. (Accompanying report No. 303.)

†210. Location of copper smelters in Canada—by A. W. G. Wilson, Ph.D. Scale, 197·3 miles = 1 inch. (Accompanying report No. 209.)

†215. Province of Alberta: showing properties on which samples of coal were taken for gas producer tests, Fuel Testing Division, Ottawa. (Accompanying Summary report, 1912.)

†220. Mining districts, Yukon. Scale 35 miles = 1 inch—by T. A. MacLean, B.A.Sc. (Accompanying report No. 222.)

†221. Dawson mining district, Yukon. Scale 2 miles = 1 inch—by T. A. MacLean, B.A.Sc. (Accompanying report No. 222.)

*228. Index map of the Sydney coal fields, Cape Breton, N.S. (Accompanying report No. 227.)

†232. Mineral map of Canada. Scale 100 miles = 1 inch. (Accompanying report No. 230.)

239. Index map of Canada, showing gypsum occurrences. (Accompanying report No. 245.)

240. Map showing Lower Carboniferous formation in which gypsum occurs. Scale 100 miles to 1 inch. (Accompanying report No. 245.)

241. Map showing relation of gypsum deposits in Northern Ontario to railway lines. Scale 100 miles to 1 inch. (Accompanying report No. 245.)

242. Map, Grand River gypsum deposits, Ontario. Scale 4 miles to 1 inch. (Accompanying report No. 245.)

243. Plan of Manitoba Gypsum Co.'s properties. (Accompanying report No. 245.)

244. Map showing relation of gypsum deposits in British Columbia to railway lines and market. Scale 35 miles to 1 inch. (Accompanying report No. 245.)

†249. Magnetometric survey, Caldwell and Campbell mines, Calabogie district, Renfrew county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 254.)

†250. Magnetometric survey, Black Bay or Williams mine, Calabogie district, Renfrew county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 254.)

†251. Magnetometric survey, Bluff Point iron mine, Calabogie district, Renfrew county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 254.)

†252. Magnetometric survey, Culhane mine, Calabogie district, Renfrew county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 254.)

†253. Magnetometric survey, Martel or Wilson iron mine, Calabogie district, Renfrew county, Ontario—by E. Lindeman, 1911. Scale 200 feet = 1 inch. (Accompanying report No. 254.)

NOTE.—1. Maps marked thus * are to be found only in reports.
2. Maps marked thus † have been printed independently of reports, hence can be procured separately by applicants.

†261. Magnetometric survey, Northeast Arm iron range, lot 339 E.T.W. Lake Timagami, Nipissing district, Ontario—by E. Nystrom, 1903. Scale 200 feet = 1 inch.

†268. Map of peat bogs investigated in Quebec—by A. v. Anrep, 1912.

†269. Large Tea Field peat bog, Quebec " "

†270. Small Tea Field peat bog, Quebec " "

†271. Lanoraie peat bog, Quebec " "

†272. St. Hyacinthe peat bog, Quebec " "

†273. Rivière du Loup peat bog " "

†274. Cacounapeat bog " "

†275. Le Parc peat bog, Quebec " "

†276. St. Denis peat bog, Quebec " "

†277. Rivière Ouelle peat bog, Quebec " "

†278. Moose Mountain peat bog, Quebec " "

284. Map of northern portion of Alberta, showing [illegible]on of outcrops of bituminous sand. Scale 12½ miles to 1 inch. (Accomp[illegible]ing report No. 281.)

293. Map of Dominion of Canada, showing the occurrences of oil, gas, and tar sands. Scale 197 miles to 1 inch. (Accompanying report No. 291.)

294. Reconnaisance map of part of Albert and Westmorland counties, New Brunswick, Scale 1 mile to 1 inch. (Accompanying report No. 291.)

295. Sketch plan of Gaspe oil fields, Quebec, showing location of wells. Scale 2 miles to 1 inch. (Accompanying report No. 291.)

296. Map showing gas and oil fields and pipe-lines in south-western Ontario. Scale 4 miles to 1 inch. (Accompanying report No. 291.)

297. Geological map of Alberta, Saskatchewan and Manitoba. Scale 35 miles to 1 inch. (Accompanying report No. 291.)

298. Map, geology of the forty-ninth parallel, 0·9864 miles to 1 inch. (Accompanying report No. 291).

302. Map showing location of main gas line, Bow Island-Calgary. Scale 12½ miles to 1 inch. (Accompanying report No. 291.)

311. Magnetometric map, McPherson mine, Barachois, Cape Breton county, Nova Scotia. Scale 200 feet to 1 inch.

312. Magnetometric map, iron ore deposits at Upper Glencoe, Inverness county, Nova Scotia. Scale 200 feet to 1 inch.

313. Magi[illegible] map, iron ore deposits at Grand Mira, Cape Breton county, Nova Sco[illegible] 200 feet to 1 inch.

Address all communications to—

Director Mines Branch,
Department of Mines,
Sussex Street, Ottawa.

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